Journal of the Royal Society of Arts

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AWARD OF THE BICENTENARY MEDAL FOR 1960

The Council has awarded the Bicentenary Medal for 1960 to Mr. J. Cleveland Belle. It will be remembered that this Medal is awarded annually to a person who, in a manner other than as an industrial designer, has exerted an exceptional influence in promoting art and design in British industry.

Mr. Cleveland Belle was the first Director of the first Design Centre to be instituted in a British industry—the Colour, Design and Style Centre established by the Cotton Board in Manchester in 1940. Under his leadership the Centre not only became a focus of research and an indispensable link with its industry, but also set new, and widely influential, standards of exhibition design and display. It gave great impetus to improvements in the design standards of the Lancashire textile producers.

As a Trustee of the Bianca Mosca Memorial Trust, Mr. Cleveland Belle served from 1954-1958 as one of the judges in the Women's Fashion Section of the Society's Industrial Art Bursaries Competition. Until 1959 he was a Director of Horrockses Ltd., where he was responsible for co-ordinating design and fashion policy. In his present work as a Director of Aquascutum Ltd., he is mainly concerned with the colour, design and style of that Company's productions.

Mr. Cleveland Belle is also an active Vice-President of the Incorporated Society of London Fashion Designers, and has recently been appointed to the Boards of Colman, Prentis & Varley Ltd. and Voice & Vision Ltd.

ROYAL DESIGNERS FOR INDUSTRY

On the recommendation of the Joint Committee of the Royal Society of Arts and the Royal Designers for Industry, the Council has made the following new appointments to the distinction of R.D.I.:

Stanley Morison, F.B.A. (Type Design and Typography)

Alastair Morton, F.S.I.A. (Textiles)

Sir Basil Spence, O.B.E., R.A., PP.R.I.B.A. (Exhibitions and Interiors)

and the following appointment to the distinction of Honorary R.D.I.:

Charles Eames (U.S.A.) (Furniture, Exhibitions and Interiors)

Mr. Morison is internationally recognized as a leading authority on typography and its related arts. To select only three of his principal achievements: as adviser to the Monotype Corporation he was responsible for the production of Eric Gill's

first Sans Serif type; through his association with *The Times* he has greatly influenced standards of newspaper production; and his earlier work for the Cambridge University Press may be said to have affected the design and production of scholarly books to their lasting benefit.

Mr. Morton, who is both a designer of great ability and a successful business man, is on the board of Morton-Sundour Fabrics Ltd., and of Edinburgh Weavers. Besides his own personal design work, he has been responsible for recognizing, at an early stage of development, the talent of a number of young designers who are now well known, and for putting their ideas into production, thus giving them much needed encouragement.

Although Sir Basil Spence is best known as an architect, he has also done outstanding work in the fields of exhibition and interior design. He was the co-ordinating architect for 'Enterprise Scotland', and devised highly successful sectional displays at the 'Britain Can Make It' Exhibition and the 1951 Festival of Britain. His interiors include those at Thorn House, London, and Science and Engineering laboratories at the Universities of Leeds and Southampton.

Mr. Eames has won distinction alike by his designs for furniture, interiors and exhibitions. Though furniture is perhaps his chief interest, he was responsible for the 'Good Design Show' at the Museum of Modern Art in New York, for the showrooms of the Herman Miller Company, and for other exhibitions and interiors which have been original contributions to these spheres of design. He has produced films, and his design of toys, including the House of Cards, has had a considerable influence in the United States.

INDUSTRIAL ART BURSARIES COMPETITION, 1960

Full particulars of the Competition to be held in the autumn of 1960 have now been published. The following sections will be included, and, except where otherwise stated, one Bursary of £150 will be offered in each:

ADVERTISING DESIGN (FOUR BURSARIES, ONE OF £200, ONE OF £175, AND TWO OF £150
CARPETS
DOMESTIC ELECTRICAL APPLIANCES
DOMESTIC SOLID-FUEL-BURNING APPLIANCES
DRESS TEXTILES (FIVE BURSARIES, ONE OF £250, THREE OF £150, AND ONE OF £50)
ELECTRIC-LIGHT FITTINGS
EXHIBITION DISPLAY
FILM, STAGE AND TELEVISION SETTINGS (THREE BURSARIES)
FLAT GLASS DECORATION
FURNISHING TEXTILES
FURNITURE (SEVEN BURSARIES)
LAMINATED PLASTICS
PACKAGING
POTTERY
TYPOGRAPHY
WALL-PAPER
WOMEN'S FASHION WEAR (TWO TALFO AWARDS OF £200 AND £150 RESPECTIVELY, AND ONE BURSARY, OF £150, FOR FASHION FOOTWEAR)

In addition to the above Bursaries, the Council of the Society may provide supplementary awards from the Art Congress Studentship Trust Fund and from

the Owen Jones Memorial Trust Fund. A George M. Whiley Bursary, of £150 in value, is also offered to a candidate in any section of the Competition. Associate Membership of the Society will, subject to certain conditions, also be offered to successful candidates.

The Sir Frank Warner Memorial Medal will be awarded to the candidate submitting the best design in the Set Test in either the Furnishing Textiles, Dress Textiles or Carpets section of the Competition, if this design is considered to be of sufficient merit. The medal may be awarded to a successful candidate in addition to a Bursary.

The last day for the receipt of entry forms is 10th October, 1960. A copy of the brochure containing all particulars of the Competition may be obtained from Mr. I. Jacobs, the Bursaries officer.

COMMONWEALTH FILM AWARD, 1960

As the result of a recommendation by the Commonwealth Section Committee, the Council has decided to offer a new award, consisting of a silver medal and diploma, to be known as the Royal Society of Arts Commonwealth Film Award, for documentary film production in the Commonwealth.

The object of the award is to encourage the making of documentary films designed for specific public purposes in their country of origin. The first, 1960, award will be made by the Society for a film produced with the intention of assisting progress in the fields of either Food Production or Public Health. The award is open to film production units operating in any country of the Commonwealth for the purpose of making documentary films. Films must, however, be submitted through the Government of their country of origin, and no country may enter more than two films in all.

It is expected that the results of this offer will be announced in November of this year. A public showing of the winning film will be arranged to take place during a special season of Commonwealth films which will be held at the National Film Theatre in that month.

In devising this award, the Society has been greatly assisted by advice and help from the Colonial Office, the Commonwealth Relations Office, the Central Office of Information and the British Film Institute.

TERCENTENARY OF THE ROYAL SOCIETY

Illustrated on p. 646 is the specially made crystal bowl which, in the words of the inscriptions it bears, has been 'Presented by the Royal Society of Arts to commemorate the Tercentenary of the Royal Society, 1660-1960'. The presentation was made by Mr. Oswald P. Milne, Chairman of Council, to the President of the Royal Society at Burlington House on 18th July.

The bowl, which was hand-made at the Whitefriars Glass Works, Harrow, was designed and steel-point engraved by Mr. William J. Wilson, F.S.I.A., Managing Director of that Company. It is 10½ inches in diameter and 8¾ inches high. On the front is engraved the coat of arms of the Royal Society and on the reverse

appears the emblem of the Royal Society of Arts, with the facsimile signatures of the President, the Chairman of Council and the Secretary.

On 19th July the Chairman of Council and the Secretary attended the formal opening of the tercentenary celebrations, which was held at the Albert Hall in the presence of Her Majesty The Queen.

THE SOCIETY'S CHRISTMAS CARD

As announced in the last issue of the *Journal*, the Christmas Card for 1960 will show a picture, specially painted by Miss Anna Zinkeisen, R.O.I., R.D.I., commemorating the trial of ships' models held by the Society on Peerless Pond in the City of London in September, 1762.

An order form for the card, including details of prices (which are in all cases the same as last year), is published at the back of this issue of the *Journal*. A reproduction of Miss Zinkeisen's painting will be published as soon as possible.

NEW HONORARY CORRESPONDING MEMBER OF THE SOCIETY

The Council has appointed the following to be an Honorary Corresponding Member of the Society in place of the late Colonel W. J. Brown:

Western Ontario, Canada: S. E. Weir, Q.C., Weir and Associates, Canadian Bank of Commerce Building, Dundas and Richmond Streets, London, Ontario.

ERRATUM

It is regretted that in the list of newly elected Fellows of the Society printed on p. 475 of the June issue of the *Journal*, an incorrect address was given for Mr. A. C. Howatson. Mr. Howatson lives in Westmount, Quebec, Canada.

MEETING OF COUNCIL

A meeting of Council was held on Monday, 11th July. Present : Mr. Oswald P. Milne (in the Chair); Mrs. Mary Adams; Sir Hilary Blood; Lord Bossom; Mr. R. E. Dangerfield; Sir George Edwards; Mr. P. A. Le Neve Foster; Mr. E. Maxwell Fry; Mr. John Gloag; Sir Ernest Goodale; Mr. Milner Gray; Dr. R. W. Holland; Mr. Edgar Lawley; Lord Nathan; Mr. Paul Reilly; Sir Gilbert Rennie; Mr. A. R. N. Roberts; Sir Philip Southwell; Professor S. Tolansky; Mr. C. E. Vignoles; Mr. Hugh A. Warren, and Miss Anna Zinkeisen; with Dr. K. W. Luckhurst (Secretary); Mr. G. E. Mercer (Deputy Secretary), and Mr. J. S. Skidmore (Assistant Secretary).

ELECTIONS

The following candidates were duly elected Fellows of the Society (those whose names are marked with an asterisk were elected Benjamin Franklin Fellows):

Akmal, M. Sadik, Kampala, Uganda, B.E. Africa.
Blackledge, William, Leeds.
*Deskey, Donald, New York, N.Y., U.S.A.
Eley, Geoffrey Cecil Ryves, C.B.E., London.
*Farley, James Aloysius, New York, N.Y., U.S.A.
Feodoroff, Professor Nicholas V., B.S., D.C.E., New York, N.Y., U.S.A.
Foley, Harold Scanlon, B.Com., LL.D., Vancouver, B.C., Canada.
Frankland, Eric Trevor, London.
Geddes, Reay Mackay, O.B.E., London.
Goulty, George Arthur, A.A.Dipl., A.R.I.B.A., Fareham, Hants.
Hardy, Harry, Eastbourne, Sussex.
Hipkins, Leslie Michael, B.A., Ilford, Essex.
Holbrook, William James, Woodford Green, Essex.
Humphreys, Dennis, Beddgelert, Caernarvonshire.
*Johnson, Philip Cortelyou, A.B., B.Arch., New York, N.Y., U.S.A.
Jones, Marcus Llewellyn Bruss, A.M.I.Mech.E., A.R.Ae.S., Amersham, Bucks.
Kitching, Geoffrey, Stockton, Co. Durham.
Laky, Mrs. Zyta, Carmel-by-the-Sea, California, U.S.A.
Lawrence, Miss Sylvester Mary, A.T.C.L., Durban, Natal, South Africa.
Lloyd, William Vivian, Ph.D., M.Sc., Dip.Ed., A.R.I.C., Welwyn Garden City, Herts.
*Lord, Milton Edward, Boxford, Mass., U.S.A.
Martyn, Roy Bruce, Dipl.Arch. (Oxford), A.R.I.B.A., Port of Spain, Trinidad.
Melhuish, Ronald, Yaba, Lagos, Nigeria.
Packer, Miss Madge Dorothy, Coventry.
Pearson, Tony Joseph Thomas, B.Sc., Kidderminster, Worcs.
Porter, Arthur, M.Sc., Ph.D., M.I.E.E., Saskatoon, Saskatchewan, Canada.

Roberts, Miss Marigold Willoby Tower, Tonbridge, Kent.
Scriven, Mrs. Constance Esme, Chard, Somerset.
Stevenson, William Lennie, O.B.E., F.S.A.E., Liverpool.
Stovell, Harry Desmond, London.
Sydie, John Errol, B.A., Edmonton, Alberta, Canada.
Tallents, Martin Francis, B.A.(Arch.), Dartford, Kent.
Varlan, Dr. Gaston Edouard, Neuilly s/Seine, France.
Weihman, Clifford T., Pelham Manor, N.Y., U.S.A.
Wernher, Sir Harold, Bt., G.C.V.O., Luton Hoo, Beds.
Wray, William Richard, M.A., Middlesbrough, Yorks.
Wynn, Gordon Kenneth, B.Sc., F.R.A.I.C., Edmonton, Alberta, Canada.

The following candidate, winner of an Industrial Art Bursary, was elected an Associate of the Society:

Coysten, Brian Michael, N.D.D., London.

The following Companies were admitted into association with the Society:

The De La Rue Company Ltd., London.
Josiah Wedgwood & Sons Ltd., Stoke-on-Trent.

ELECTION OF CHAIRMAN OF COUNCIL

Mr. Oswald P. Milne was unanimously re-elected Chairman of Council for the coming year.

NOMINATION BY THE PRESIDENT

It was reported that H.R.H. the President nominated Sir Harold Wernher, Bt., G.C.V.O., to be a Vice-President of the Society.

AWARD FOR JOURNALISM

Approval was given to a proposal that the Society should offer an award for journalism in the Commonwealth.

NEW HONORARY CORRESPONDING MEMBER

Approval was given to the appointment of a new Honorary Corresponding Member of the Society in Western Ontario (see separate Notice on p. 646).

OTHER BUSINESS

A quantity of financial and other business was transacted.

206TH ANNUAL GENERAL MEETING

WEDNESDAY, 29TH JUNE, 1960

MR. OSWALD P. MILNE, F.R.I.B.A., J.P.,
Chairman of Council of the Society, in the Chair

The 206th Annual General Meeting was held on Wednesday, 29th June, 1960, at 3 p.m. at the Society's House, in accordance with the Bye-laws, for the purpose of receiving the Council's Report and the Financial Statements for 1959, and for the election of officers.

The Secretary read the Notice convening the meeting and proved that it had been duly exhibited and published, as required by the Bye-laws.

The Minutes of the last Annual General Meeting, held on 1st July, 1959, were then taken as read, the Secretary having summarized their contents, and were signed by the Chairman as a correct record.

The Chairman then called upon the Secretary to summarize the Annual Report of the Council.

ANNUAL REPORT OF THE COUNCIL

206th SESSION 1959–60

I. H.R.H. THE PRESIDENT

The success of the first annual reception of the Society on 3rd March (see Section VII) was in large measure due to the attendance of the President, who paid one of his longest visits to the Society's House for this event. During the evening a number of Fellows were presented to His Royal Highness, who moved freely amongst the guests.

In the previous July, the Duke of Edinburgh, who was then in Canada with the Queen, presented the Albert Medal for 1959 to Mr. Vincent Massey at an informal ceremony held at Government House, Ottawa.

II. ALBERT MEDAL

With the approval of the President, the Albert Medal for 1960 was awarded to Sir Frederick Handley Page, C.B.E., 'for leadership in the design and manufacture of aircraft'.

III. BICENTENARY MEDAL

The Bicentenary Medal for 1960 was awarded to Mr. J. Cleveland Belle.

IV. BENJAMIN FRANKLIN MEDAL

With the approval of the President, the Benjamin Franklin Medal for 1960 was awarded to Mr. Robert Nicholson, F.S.I.A., 'for skill in design'.

V. R. B. BENNETT COMMONWEALTH PRIZE

In accordance with a recommendation of the Commonwealth Section Committee regarding the award of this prize for 1960, the Council will shortly submit a name for the President's approval.

VI. ROYAL DESIGNERS FOR INDUSTRY

Professor R. Y. Goodden served as Master during the year under review, and Professor R. D. Russell as Deputy Master.

Three new Royal Designers for Industry were appointed in June, 1960: Mr. Alastair Morton (for Textile Design), Mr. Stanley Morison (for Type Design and Typography) and Sir Basil Spence (for Exhibition and Interior Design). Mr. Charles Eames, the well-known American designer, was appointed to the Honorary Distinction for his work in Furniture and Exhibition and Interior Design.

During the year the Faculty lost two of its oldest members. Mr. Tom Purvis, past Master, died on 27th August, and Sir Ambrose Heal, a former recipient of the Albert Medal, on 15th November. The death also occurred of Mr. Charles Holden, who was appointed to the distinction in 1943.

The tenth annual reception of the Faculty was held at the Society's House on the 4th February. An interesting and much appreciated innovation at this reception was the arrangement of an informal exhibition showing the work of R.D.I.s in the field of transport design.

On 30th November, at a Special Meeting of the Society, the Chairman of Council, Mr. Oswald P. Milne, presented Diplomas to Mr. Robin Day, Mr. Abram Games, Mr. F. H. K. Henrion, Mr. Hans Schleger and Mr. Berthold Wolpe, appointed R.D.I. last June, and to Mr. Hans Wegner, appointed Honorary R.D.I. At the same meeting the Master delivered an oration entitled 'Faith and Fancy'.

Before this meeting the Faculty, in association with the Council, gave a party in honour of the five new R.D.I.s and their wives, who were also formally entertained to dinner by the Faculty at the Society's House on 6th January. The Master also gave a small informal party, on 3rd December, 1959, in honour of Mr. and Mrs. Hans Wegner.

Sir Gordon Russell, R.D.I., read two papers to the Society on 'Modern Trends in Industrial Design', on 9th December and 23rd March.

As in previous years, the Society owes a debt of gratitude to those R.D.I.s who have given freely of their time and knowledge in assisting the judging of designs submitted in the Society's Industrial Art Bursaries Competition.

VII. ANNUAL RECEPTION

The first annual reception of the Society to be held in modern times took place at the Society's House on the evening of 3rd March. It was attended by His Royal Highness the President, a number of distinguished guests, and some 400 Fellows of the Society and their wives, who were received by the Chairman of Council and Mrs. Milne. The evening's arrangements included a small exhibition commemorating that held under the Society's auspices in 1760 (the precursor of the annual summer exhibitions of the Royal Academy), two recitals of music by the Musica da Camera quintet, and a film show. The presence of the Duke of Edinburgh, and the pleasure given to the company by these entertainments and the sight of the Society's House *en fête*, all contributed to the success of this reception, which the Council intends to make an annual event.

A fuller account of the reception, and a description of the exhibition, were published in the April issue of the *Journal*.

VIII. RESTORATION OF THE BARRY PAINTINGS

The cleaning and restoration of the great paintings by James Barry in the Lecture Hall, which was carried out during September, produced a striking

improvement in their appearance, which has been widely remarked. Though carefully maintained, the paintings had not received so thorough a cleaning for many years, and they are now in a state both to reveal the full beauty of their design and to withstand a considerable further period of exposure to the London atmosphere.

IX. BENJAMIN FRANKLIN FELLOWS

The scheme for the appointment of a number of American citizens as Benjamin Franklin Fellows, which was mentioned in the last Annual Report as being under active consideration, has now materialized, and by the June meeting of Council 142 Benjamin Franklin Fellows had been elected, of whom 32 were already Fellows of the Society. The Council warmly appreciate the support which is thus being given to the Society by a group of men and women of high standing in the United States, and they are grateful to the small committee of American Fellows, presided over by General Sarnoff, who have, in co-operation with the Council, selected those invited to accept this honour.

X. HONORARY CORRESPONDING MEMBERS

During the past year the Council has continued its policy of extending its system of Honorary Corresponding Members. In addition to three new Honorary Corresponding Members in Canada (for Alberta, Saskatchewan and Manitoba respectively), the Society now has Fellows serving in a similar capacity in Pakistan, and Victoria, Australia. Details of these appointments were announced in the issues of the *Journal* for March, May and June, 1960.

During the year the Society suffered a serious loss in the death of Colonel W. J. Brown, of London, Ontario, who was the first, and had for many years been the only, Honorary Corresponding Member in Canada. Colonel Brown was also the first Honorary Corresponding Member to be elected a Vice-President of the Society, under a clause which was added to the Bye-Laws in 1957.

XI. COMPANIES IN ASSOCIATION

Mindful of the fact that 'the encouragement of manufactures and commerce' is one of the Society's chief aims, as is shown by its full title, the Council during the past year introduced a scheme, approved at the last Annual General Meeting, whereby limited liability companies and other trading bodies might be admitted into a form of association with the Society. It is hoped that by these means leading business organizations may keep and be kept in close touch with the activities of the Society, and may seek the Society's help and advice in matters of mutual concern.

There has been an encouraging response to the scheme, and so far 53 companies, many of them of national importance in the industrial and commercial field, have been admitted into association. A valuable nucleus has thus been

formed, and it is hoped that the number of admissions will increase as this type of corporate membership becomes better known in the world of industry and commerce.

XII. EXAMINATIONS

Once again there has been a very satisfactory increase in the number of subject-entries for the various examinations offered by the Society. The total for the Session 1959-60 is 409,233, as against 346,267 in 1958–59—an increase of 62,956.

The following table gives comparative details:

	1959–60	1958–59
(*a*) Ordinary (Single-Subject)	302,037	252,691
(*b*) School and Senior School Certificates	65,610	51,069
(*c*) Oral Tests	8,291	7,423
(*d*) Grouped Course	29,107	31,063
(*e*) Teacher's Certificate in Shorthand	1,103	818
(*f*) Teacher's Certificate in Typewriting	616	504
(*g*) Road Transport Subjects	1,232	1,282
(*h*) British Transport Commission (Preliminary examination of candidates under Apprenticeship Schemes) ...	1,084	1,349
(*i*) Royal Air Force Administrative Apprentices (Endorsement of certificates awarded by the Air Ministry) ...	143	68
	409,233	346,267

This continuing increase in the demand for the Society's examinations must surely indicate that they are meeting a need, and meeting it to the general satisfaction of local education and school authorities throughout the British Isles, as well as in certain parts of the Commonwealth. The certificates awarded are recognized by employers as of great value in the selection, and promotion, of office personnel.

The rapid expansion of the work of the Examinations Department in recent years, however, has created many problems, especially in regard to accommodation and staff. With the use of the Exhibition Rooms in 18 Adam Street for clerical purposes during the very busy period from June to August, and the help of numerous students as temporary clerks in that period, it has been possible up till now to cope with the pressure of work, but these emergency measures will not suffice in the future as the ever-increasing demand is spread over all Series of examinations—Autumn, Easter, Whitsun, and Summer. The Council have therefore given detailed consideration to this problem and there is every hope that in the near future additional accommodation in the Society's buildings will be available.

The scheme of examination for the award of School and Senior School Certificates has continued to create a great deal of interest. An important and extremely valuable result of the development of this scheme is the encouragement it is giving to increasing numbers of pupils to stay on at school for the completion

of a five-year course of study. In 1960 entries were received from 9,173 candidates in the British Isles and 812 candidates in Nigeria; the total numbers of subject-entries were 59,981 and 5,629 respectively. Consideration is now being given to the inclusion in this scheme of examinations in music and rural science.

For the examinations for the award of Teachers' Certificates in Shorthand and Typewriting there has also been a substantial increase in entries. These certificates are recognized by the Ministry of Education and by local education authorities as a teacher's qualification in the respective subjects. In 1961 a revised scheme for these certificates will be introduced (details were published last autumn). In May, 1960, special papers in Braille Shorthand were prepared for a blind candidate wishing to obtain the Society's Teachers' Certificate in Shorthand; if at all possible, it has always been the Society's policy to help candidates afflicted with this disability.

Of the special examinations conducted by the Society there has been a slight drop in the number of entries for those in Road Transport subjects, and also for those organized on behalf of the British Transport Commission. For the latter, however, there were no entries in connection with the apprenticeship scheme of British Waterways, which was included for the first time in 1959.

During the Session there have been, as usual, a large number of meetings of the various committees connected with the examinations. On these committees the Society has enjoyed, and valued, the help and advice of local education officers, inspectors of education, head teachers, and specialist teachers, and of representatives of professional bodies and business organizations.

Three Silver Medallists in the Society's examinations in 1959 have been elected to Associate Membership.

The Worshipful Company of Clothworkers has again generously contributed towards the cost of the silver and bronze medals.

A fuller report on the Society's examinations during the past year will be published in the *Journal* in the autumn.

XIII. INDUSTRIAL ART BURSARIES COMPETITION

The steady and healthy growth of the Society's annual Competition for bursaries to enable students of industrial design to travel abroad, continued in 1959. In all, 653 candidates, from 81 schools and industrial establishments, entered the Competition. The previous record figure, of 495 candidates from 80 schools, was reached in 1958.

Altogether 34 Bursaries, amounting in value to £4,425, were awarded. Ten of the candidates who won these Bursaries were between 18 and 21 years of age and eligible for Associate Membership of the Society, to which they have now been elected.

The Competition included sections for the design of: *domestic electrical appliances; electric-light fittings; domestic solid-fuel-burning appliances; carpets;*

dress textiles; furnishing textiles; women's fashion; acrylic sheet ('*Perspex*'); *laminated plastics; film, stage and television settings; footwear; flat glass decoration; furniture; packaging; pottery, typography*, and *wall-paper*.

As usual, an illustrated report on the Competition was published, and a summary of this was included in the April issue of the *Journal*. The annual exhibition of winning and commended designs was held this year in the exhibition rooms on the first floor of the Society's extension premises, and was opened by Mr. Whitney Straight on 17th May, in the presence of an audience which included many of the successful candidates and their teachers, together with representatives of the supporting industries and the jurors responsible for judging the Competition. A special Press View preceded the official opening. (A report of the opening ceremony was published in the July issue of the *Journal*.) The exhibition will subsequently be shown in Belfast, Liverpool, Coventry, Sunderland and Sheffield.

Arrangements were made during 1959 for the exhibition of the winning and commended entries in the 1958 Competition to be shown at the School of Art, Royal Melbourne Technical College, Melbourne, Australia, which had specially requested the loan of the exhibition.

During 1959 thirty-two of the Bursary winners in the 1958 and previous Competitions travelled either on the Continent or, with the help of additional money received from other sources as a result of their Bursary awards, to the United States, Canada and Mexico. Details of these tours are given in the official report. It is expected that over fifty of the winning candidates in the 1959 and previous Competitions will undertake visits later this year or in the spring of 1961. Arrangements are also being made for a number of them, together with some of the commended candidates, to gain practical experience by visiting factories and design studios in this country.

During 1959 the Industrial Art Bursaries Board carried out two separate reviews in connection with these annual competitions.

In the first review, which sought to ascertain the value of the Competition as a whole, a questionnaire was sent to many of those directly concerned with it, including the principals of some twenty of the larger schools. The view expressed by the great majority was that the Competition is meeting a widespread need, and that the Society should continue to organize similar Competitions in the future. Many suggestions were also received for the extension of the Competition to cover a still wider range of industrial and commercial needs, and these the Board has carefully noted.

The second review was undertaken to ascertain details of the subsequent careers of those students who have won Bursaries since 1946. (A summary of the information thus obtained will be found on page 54 of the official report.) It gave much satisfaction to the Board, and to the Society's Council, to learn that the majority of these young designers attribute their present career, at least in part, to their success in these Competitions, and all pay tribute to the opportunity which the Bursaries provided, at the outset of their careers, to broaden their outlook and experience.

The results of these reviews have fully confirmed the Council's belief in the value of these Competitions and its intention to continue them.

A further Competition is to be organized in 1960 in which awards of the total value of £5,225 will be offered, covering eighteen fields of industrial design. All the sections of the 1959 Competition, with the exception of that for Acrylic Sheet ('Perspex'), will be included, together with two new sections, for Advertising Design and Exhibition Display respectively. Details of this Competition are announced on page 644 of this issue of the *Journal*.

The Council and the Bursaries Board take this opportunity of offering their renewed thanks for the financial support which sections of industry continue to give to these Competitions; and also for the kind co-operation of those responsible for judging the work submitted.

XIV. PAXTON MEMORIAL TRUST BURSARIES

In 1959 for the first time the Society offered a Paxton Memorial Trust Bursary to assist a British student taking up horticulture as a career to study its practice in the United Kingdom or overseas. The funds for this Bursary are derived from the Paxton Memorial Trust, which was endowed by the late Miss Violet Markham, C.H., in memory of her grandfather, Sir Joseph Paxton.

Applications were invited from those who had qualified in 1959 for the National Diploma of Horticulture, and eleven were received. Of these, it was decided that two, from Mr. I. G. Walls and Mr. B. E. Steane respectively, were so close in merit as to justify the award of a bursary of £50 to each of these candidates. Details of the use which Mr. Walls and Mr. Steane propose to make of this money were published in the April issue of the *Journal*.

The advisory committee which judged the applications and made the above recommendation consisted of Sir Ernest Goodale (Chairman), the Earl of Radnor, Mr. P. E. Cross (a Fellow of the Society), and the Honble. Lewis Palmer, representing the Royal Horticultural Society, which provided valuable help in the general organization of the Competition.

XV. THOMAS GRAY MEMORIAL TRUST

The funds available under the terms of the Thomas Gray Memorial Trust (which is concerned with 'the advancement of the science of navigation and the scientific and educational interests of the British Mercantile Marine') have been used during the year to finance the following grants and awards:

Scholarships for Deck-Boys and Young Seamen

A further grant of £85 was made towards the provision of scholarships for deck-boys and young seamen under the scheme financed by the Trust and administered by the Seafarers' Education Service.

Prizes for Ships' Apprentices

Fifteen prizes (five silver medals, five bronze medals and five nautical

instruments) were awarded to the boys who achieved the highest marks in the examinations conducted by the Merchant Navy Training Board.

Training Ship Prizes

Prizes to a total value of £30 offered to the training ships *Arethusa*, *Indefatigable* and *Mercury* for the boy in each ship who, in the opinion of his officers, would make the best sailor, were awarded to Olav Nicholay Sivertsen of *Arethusa* (£10), Ian Haward Saull-Hunt of *Indefatigable* (£10) and Mark Grandis of *Mercury* (£10).

The Society's silver medal, offered as a navigation prize to a cadet at the South African Nautical College *General Botha*, was awarded to Senior Cadet C. A. Harwood of Johannesburg.

Extra Chief Engineer's Certificate

In 1959 the Society offered for the first time a silver medal to the candidate who should obtain the highest marks in the Ministry of Transport's Examination for the Extra Chief Engineer's Certificate, and this award was won by Mr. Nitibhusan Chakraborty.

Deed of Professional Merit

Only one submission was received in connection with the Society's offer of a silver medal for a deed of outstanding professional merit performed at sea by a member of the British Mercantile Marine between October, 1958, and September, 1959, but the Society considered that the deed reported fully justified the award of the medal to Captain Ryder of M.S. *Shell Roadbuilder*. Captain Ryder's efforts to rescue M.S. *Widdale H* at Nash Point on the 1st April, 1959, were described in the *Journal* for May, 1960.

XVI. ENDOWED PRIZES

Offers of prizes were this year again made under the terms of the Howard and Fothergill Trusts. The Howard prize of £50 was subsequently awarded to Mr. A. N. Byford, M.I.C.E., M.I.Mech.E., for his essay entitled 'A Possible Nuclear Reactor System for the Propulsion of Smaller Ships'. A Fothergill prize of £10 was awarded to Mr. E. C. Simpson for his suggestion to ensure 'Safety in Paraffin Oil Heaters'. Mr. Simpson's essay, and the full results of these two Competitions, were published in the *Journal* for November, 1959 (p. 791).

XVII. AWARD FOR CHILDREN'S ART

In 1958 the Council resumed an earlier practice of the Society by offering the award of a bronze medal in connection with the Royal Drawing Society's Exhibition of Children's Art. It has now been decided that this shall be an annual practice. The 1960 award of the medal was accordingly made to Christine Forrester, aged 15, a pupil at Albany Secondary Modern School, Cardiff, for her painting 'In the Ring', which was included in the Royal Drawing Society's exhibition this year.

XVIII. FUTURE POLICY COMMITTEE

The Future Policy Committee, which was appointed in 1958 'to review the present activities of the Society with the object of ensuring that its aims are being pursued in the most suitable and rewarding manner', has continued during the year its examination of the Society's affairs.

The Committee has this year been particularly concerned to extend the Society's activities in other parts of the United Kingdom, and the Council has agreed that exploratory meetings should be held in important provincial centres to discuss with local Fellows the possibility of arranging activities in those places. A very successful first meeting was held in Birmingham in May (a report of this appeared in the June *Journal*), and it is hoped to arrange one or two functions for Midland Fellows in the next Session. Consideration is also being given to the possibility of arranging similar meetings elsewhere.

On the Committee's recommendation, it has also been agreed to arrange annually two dinners at the Society's House to entertain distinguished guests, such as leading industrialists, scientists and artists. It is believed that the fostering of such useful contacts by introducing these prominent persons to the work of the Society will have valuable results. The first dinner was held on the 25th May, when the guest of honour was Sir Duncan Oppenheim, Chairman of the Council of Industrial Design and of the Council of the Royal College of Art, and others present included representatives of many of the firms who so generously contribute each year to the Industrial Art Bursaries Competition.

The Committee considered and endorsed the proposals of the Commonwealth Section Committee for the institution of the award of a silver medal to the producer of a documentary film made in the Commonwealth and to an outstanding journalist in the Commonwealth, and detailed arrangements for the film award are now completed (see Section XX, and page 645 of this issue of the *Journal*).

In accordance with the traditions of the Society, the Committee has also considered how encouragement might best be given to promising students in technological fields, and as a result of its recommendation the Council is now consulting the appropriate authorities about the award of a silver medal to 'the most outstanding student' in each of the three constituent colleges of the Imperial College of Science and Technology, in the Manchester College of Science and Technology and in each of the new Colleges of Advanced Technology.

The Committee still has under review certain important fields of activity in which the Society may be able to play a useful part, but it is expected that its present task will soon be completed.

XIX. SPECIAL ACTIVITIES COMMITTEE

The Special Activities Committee met several times during the year to discuss matters in which it seemed that the Society might take useful action.

It was noted with interest that the President of the Board of Trade in 1959

set up a Departmental Committee to consider the protection of industrial designs, a matter on which the Committee had addressed the Board of Trade in the previous session.

The Committee continued its active interest in matters affecting education and training, particularly in the scientific and technological fields. It gave serious consideration to the Report of the Central Advisory Council for Education (England) entitled *Education from 15 to 18*, and it is hoped later in 1960 to arrange a conference to consider the Report as a whole. Various aspects of apprenticeship, and particularly group apprenticeship, were also examined, and the Committee gave much thought to the contribution which the universities and technical colleges might make to training for business management. Mr. A. R. N. Roberts, the Chairman of the Committee, in October addressed the A.S.L.I.B. (Association of Special Libraries and Information Bureaux) conference on the shortage of technical text books in certain scientific fields, a matter to which the Committee has paid close attention over the last two years. It seems that the efforts of the Society and other influential groups, such as the Publishers' Association, in this direction may at last be beginning to bear fruit.

The Committee continued to be exercised about the impact of modern industrial and social development on the countryside, a subject discussed at two conferences arranged at the Committee's suggestion in 1956 and 1957. Two papers were read to the Society in November, 1959, by Sir Christopher Hinton and Sir William Holford, who concentrated on the specific problems created by 'Power Production and Transmission in the Countryside', but the Committee has been considering the much wider problems created by modern development as a whole, with a view to discovering the best way in which the Society might assist in the finding of solutions to them.

Two important meetings were also held with agricultural economists and practical agriculturalists to discuss ways and means of bringing poor land into cultivation, including the possibility of improving poor soils by the use of heavy earth-moving equipment.

XX. COMMONWEALTH SECTION COMMITTEE

The list of meetings arranged by the Commonwealth Section Committee which appears in Section XXXI of this report includes for the first time two papers ('Indians of British Columbia' and 'The Preservation of Game in East Africa') arranged in particular for the benefit of younger people. Both meetings—the second especially—attracted large audiences from grammar and secondary schools in the London area, and this initial response has encouraged the Committee to plan two further meetings of a similar kind for inclusion in the next session's programme.

The list on p. 644 also includes a meeting held jointly with the Royal Commonwealth Society, and it is hoped that this too will be the first of a series of joint meetings.

As the result of a suggestion put to the Commonwealth Section Committee in

the previous year, the Council decided that the Society should offer an award, consisting of a silver medal and diploma, to the producer of a documentary film made in the Commonwealth. With the co-operation of the Colonial Office, the Commonwealth Relations Office, and the governments concerned, this offer was promulgated in May, and the award will be announced in the autumn. Another proposal, for a similar award to a Commonwealth journalist, is under consideration.

XXI. EDMUND RICH MEMORIAL TRUST

In fulfilment of a wish expressed by her late husband (a former Vice-President and Member of Council of the Society, and some time Chief Education Officer to the London County Council), Mrs. Edmund Rich has given a sum of £500 to the Society, therewith endowing a periodical 'Edmund Rich Memorial Lecture', which will be devoted in each case to 'some educational or kindred subject chosen by the Society'.

XXII. SCIENCE AND INDUSTRY COMMITTEE

The Science and Industry Committee, which was appointed in 1954 and has been responsible jointly to the Society, the British Association for the Advancement of Science and the Nuffield Foundation, continued its investigation into the factors which influence the rate of application of new scientific and technical ideas by British industry, and produced its third and final report, entitled *Science in Industry*, in November. This report, which was reviewed in the April issue of the *Journal*, offered practical suggestions for policy and action by industry and the Government. Its publication completed the Committee's work, and the Committee itself was disbanded at the end of 1959.

XXIII. THE LIBRARY

The Library has again benefited from a number of gifts. Of particular value were *The Works in Architecture of R. & J. Adam* (Tiranti, 1960) and a further volume in the series *Survey of World Textiles*. The presentation by the Royal Dublin Society of their most up-to-date history, in response to an inquiry for bibliographical details, was greatly appreciated.

The rebinding of the early printed works, as well as of manuscript committee minutes, has continued. The volume of committee minutes for 1826–7, containing details of the award made to James Burn for his book press, was loaned to the National Book League for the exhibition of Business History in March. Some of the Society's original prize-winning designs for 1756–8 were lent to the Victoria and Albert Museum in May for the exhibition of English Chintz.

Work on the archives has continued and a number of students have consulted them. The collection has been enlarged by the gift from Lord Radnor of a letter, dated 10th July, 1774, which was addressed to his ancestor, the first Earl of Radnor, and originally intended for communication to the Society. The following articles in the series 'Studies in the Society's Archives' have been published in the *Journal:*

'The Society of Arts and the Lunar Society of Birmingham', Part II, by Robert E. Schofield (August, 1959).

'Thomas Wilkins, the Society's Printer, and Lord George Gordon', by D. G. C. Allan (October, 1959).

'Joseph Bramah and His Family as Members of the Society, 1783–1845', by R. W. Allott (December, 1959).

'Colonel William Tatham, an Anglo-American Member of the Society, 1801–4', by D. G. C. Allan (February, 1960).

'Dr. Peter Templeman and His Appointment as Secretary of the Society in 1760', Parts I–II, by W. Campbell Smith (May and July, 1960).

XXIV. FILM EVENINGS

Three Film Evenings were held during the session. The programmes shown attracted full attendances by Fellows of the Society and their guests, and on two occasions the producers of films about to be screened came to introduce their work in person. Amongst the films seen on these evenings were two concerned respectively with the building of the Kariba dam and the consequent rescue of endangered game; *Antarctic Crossing*, which followed the course taken by Sir Vivian Fuchs' party in 1957–8; *Borgo a Mozzano*, the story of a Tuscan experiment in community development; *Coupe des Alpes*, describing the 1958 Alpine Rally, and accounts of the craft practised by *The Glassmakers* and of the *Team Work* which produced a giant sculpture.

XXV. THE SOCIETY'S CHRISTMAS CARD

The Society's Christmas Card for 1959 again had the advantage of being designed by Miss Anna Zinkeisen, whose painting of T. R. Crampton and his famous railway engine, the 'Namur', in a winter setting, gaily commemorated the award of the Society's gold medal to this inventor in 1846. Though increased printing charges caused the price of the cards to be higher than in previous years, over 34,000, a record number, were sold.

XXVI. FELLOWSHIP

The number of Fellows on the roll after the Council meeting in June was 6,441, as compared with 6,208 at the same time last year.

This indicates the healthy condition not only of the Society, but of the country's economy generally. The membership of a non-professional body is often a pointer to the state of trade, and it is satisfactory to record that in recent years the Fellowship figures have been increasing steadily. None of this increase derives from any relaxation by the Membership Committee of its scrutiny of applications; no candidate is recommended for election unless the Committee is properly satisfied as to his suitability.

The election of a number of distinguished United States citizens as Benjamin Franklin Fellows is recorded for the first time. This special category of Fellowship was instituted to commemorate Benjamin Franklin's personal association with the Society, and to strengthen the Society's own links with the United States.

XXVII. OBITUARY

In January occurred the death of Sir Edward Crowe, who, with the exception of Her Majesty the Queen, was the only surviving former President of the Society. This past year also brought the loss of Colonel W. J. Brown, the first overseas Vice-President of the Society, who was the Society's Honorary Corresponding Member in Canada for over twenty years, of three former Vice-Presidents, Major W. H. Cadman, Mr. H. S. Goodhart-Rendel and Sir Henry Tizard, and of a recently retired Member of Council, Mr. A. C. Hartley. The deaths were also recorded of two past recipients of the Albert Medal, Sir Ambrose Heal (who was also a Royal Designer for Industry) and Sir Giles Gilbert Scott, and of the American benefactor Mr. James Hazen Hyde, who made a generous contribution to the Fund for the Preservation of Ancient Cottages, instituted by the Society in 1931.

In addition to memoirs of these gentlemen, the *Journal* contained obituary notices of the following Fellows: Sir Albert Braithwaite, a Conservative Member of Parliament for many years; Mr. A. Digby Besant, a much respected figure in the world of insurance; Mr. Howard Coster, the photographer; Mr. J. S. Entwistle, who was closely associated with the organization of the Society's Bicentenary Banquet in Toronto in 1955; Mr. Thomas Girtin, a noted connoisseur of water-colour painting; Mr. T. E. Goldup, the radio engineer; Admiral Sir Arthur Hall, under whose direction education and training in the Royal Navy were greatly improved; Sir William McCallum, a leader of the European business community in the Argentine; Sir Ronald Matthews, formerly Chairman of the London and North Eastern Railway; Mr. Nevile Shute Norway, celebrated as Nevile Shute, the novelist; Mr. R. J. S. Muir, a prominent figure in the Australian sugar industry, and Mr. Bradford Williams, the Society's Honorary Corresponding Member in Boston and a widely consulted American landscape architect.

XXVIII. NEW COUNCIL

The Council has put forward for the office of Vice-President the name of Professor Simon Lissim, the Society's senior Honorary Corresponding Member in the United States. Professor Lissim acted as secretary of the special committee which recommended the names of those subsequently elected Benjamin Franklin Fellows of the Society.

In accordance with the Bye-Laws four Ordinary Members of Council retire this year. They are: Sir Griffith Williams, Lord Latham, Mr. Antony Hopkins and Mr. William Johnstone. In their place the Council recommends the election of Lord Conesford, Sir Charles Dodds, Mr. J. C. Jones and Lord Netherthorpe.

XXIX. STANDING COMMITTEES

The lists of those appointed to serve on the Standing Committees of the Society, and of the Society's representatives on the governing bodies and committees of certain other organizations, were published on pp. 75–9 of the December, 1959, issue of the *Journal*.

XXX. FINANCE

The Income and Expenditure Account for 1959 shows the satisfactory result of a total favourable balance of £9,130. By a decision reached by the Council last year, half of this surplus of income is carried to the fund for the purchase of the adjoining premises, in addition to the amount of £5,000 which is to be annually transferred to that fund and was already provided for before the figure of £9,130 was reached.

It will be remembered that the lease which the Society obtained in 1957 from the Legal and General Assurance Society Limited made the generous provision that between the fourteenth and twenty-first years of the lease the Society might purchase the property from the present freeholders for the amount paid by the latter at the time when they purchased the property and granted lease. Although, therefore, the Council may no doubt invite the assistance of Fellows when the time for the purchase becomes nearer, they have decided, as was stated in the *Journal* for November, 1959, to set aside annually a fixed amount, viz., £5,000, plus half of the surplus of income over expenditure.

XXXI. LECTURES AND PAPERS

The programme of Lectures and Papers during the past Session covered a range of subjects perhaps less wide than in previous years, since it had been decided by the Council that several series of papers devoted to different aspects of the same subject should be included. These series—notably those on the economy of this country and on the transport system—accomplished the first stage in a plan whereby development in fields of special importance to the national well-being will be treated to a thorough review in the course of the next few years. Though this element of continuity has been introduced, however, the Council fully intends that the varied character of the Ordinary Meetings shall be preserved, since diversity of interest is the Society's essential characteristic.

ORDINARY MEETINGS

Chairman's Inaugural Address

THE ROYAL SOCIETY OF ARTS: ITS PAST, PRESENT AND FUTURE. *Oswald P. Milne* (page 7)

Trueman Wood Lecture

THE EXPLORATION OF OUTER SPACE. *Professor A. C. B. Lovell* (page 496)

Peter Le Neve Foster Lecture

THE WRITING OF DANIEL DEFOE. *Professor Bonamy Dobrée* (27th April)

Alfred Bossom Lecture

THE CRISIS OF URBAN ENGLAND. *The Honble. Lionel Brett* (1st June)

Armstrong Memorial Lecture

RECENT ADVANCES IN FOOD PRESERVATION. *W. B. Adam* (page 167)

Fred Cook Memorial Lecture

FOUR REPRESENTATIONAL PORTRAIT PAINTERS. *Sir Gerald Kelly* (27th January)

Fernhurst Lecture

INDUCED MUTATIONS IN CROP PLANTS—PROSPECTS AND PERSPECTIVES. *Dr. D. Roy Davies* (page 596)

Sir William Jackson Pope Memorial Lecture

MODERN DYES. *Clifford Paine* (page 426)

Papers

THE PRESENT ECONOMIC POSITION OF GREAT BRITAIN. *Professor C. F. Carter* (page 97)

PROBLEMS AND PROSPECTS OF THE ECONOMIC POSITION OF GREAT BRITAIN. *Professor C. F. Carter* (page 110)

POWER PRODUCTION AND TRANSMISSION IN THE COUNTRYSIDE: PRESERVING AMENITIES. (*Two papers.*) *Sir Christopher Hinton and Sir William Holford* (page 180)

MODERN TRENDS IN INDUSTRIAL DESIGN. (*Two papers.*) *Sir Gordon Russell* (page 565)

THE TRAINING OF STAFF FOR FOREIGN POSTS: A DUTCH EXPERIMENT. *Dr. E. B. J. Postma* (page 391)

THE FUNCTION OF MANAGEMENT IN INDUSTRY AND COMMERCE. *Sir Frederic Hooper* (page 257)

THE ART OF GLASS ENGRAVING. *Helen Monro* (page 477)

THE TRAINING OF BRITISH STAFF FOR OVERSEAS POSTS (Symposium). *W. H. Beeton, B. F. Macdona, A. R. Thomas* and *Dr. A. T. M. Wilson* (page 406)

SCIENTIFIC METHODS IN THE CARE OF WORKS OF ART. *F. I. G. Rawlins* (page 519)

A Series of Five Papers on TRANSPORT

THE STRUCTURE AND ORGANIZATION OF THE INTERNAL TRANSPORT SYSTEM. *Gilbert J. Ponsonby* (30th March)

THE HOVERCRAFT AND ITS PLACE IN THE TRANSPORT SYSTEM. *Christopher Cockerell* (6th April)

FUTURE DEVELOPMENTS OF THE INTERNAL SYSTEM OF TRANSPORT. *D. L. Munby* (4th May)

THE SHIPPING INDUSTRY TO-DAY AND TOMORROW. *Sir Robert Ropner* (11th May)

THE PROBLEMS AND PROSPECTS OF AIR TRANSPORT. *Peter G. Masefield* (25th May)

SPECIAL MEETING

(Presentation of Bicentenary Medals, R.D.I. diplomas)

Oration

FAITH AND FANCY. *Professor R. Y. Goodden* (page 87)

COMMONWEALTH SECTION

Sir George Birdwood Memorial Lecture

THE PATHANS. *Sir Olaf Caroe* (17th May)

Sir Thomas Holland Memorial Lecture

VOLUNTARY SERVICE OVERSEAS. *Alec Dickson* (page 442)

Henry Morley Lecture

RECENT DEVELOPMENTS IN FIJI. *Sir Alan Burns* (26th May)

Papers

BLINDNESS IN THE COMMONWEALTH. *John Wilson* (page 122)
INDIANS OF BRITISH COLUMBIA. *Mildred Valley Thornton* (page 211)
THE PRESERVATION OF GAME IN EAST AFRICA. *R. L. E. Dreschfield* (page 272)
IRRIGATION AND POPULATION IN PAKISTAN, INDIA AND CEYLON. *Dr. R. Maclagan Gorrie* (page 354)
THE COMMONWEALTH EDUCATION CONFERENCE. *Sir Philip Morris* (page 519)
CHANGING PATTERNS OF AFRICAN LAND-USE. *William Allan* (page 612)

CANTOR LECTURES

The following courses were delivered during last Session:

MODERN TECHNOLOGICAL AND COMMERCIAL EDUCATION:
I. EDUCATION FOR INDUSTRY AND COMMERCE. *A. A. Part* (page 16)
II. TECHNOLOGICAL EDUCATION. *Dr. P. F. R. Venables* (page 30)
III. COMMERCIAL AND HIGHER PROFESSIONAL EDUCATION. *Dr. A. J. McIntosh* (page 48)

THE FUEL AND POWER INDUSTRIES AND NATIONAL PROSPERITY. *Dr. Albert Parker*
I. WORLD AND NATIONAL ENERGY RESOURCES (page 316)
II. PRODUCTION AND TREATMENT OF COALS AND OILS (page 328)
III. NATURAL AND MANUFACTURED GAS (page 342)

ENERGY
I. THE GENERATION OF POWER. *Professor J. M. Kay* (page 670)
II. THE TRANSMISSION OF POWER. *F. H. S. Brown* (page 590)
III. THE RETAIL DISTRIBUTION OF ELECTRICITY. *C. Robertson-King* (page 705)

DR. MANN JUVENILE LECTURES

The following two Juvenile Lectures were delivered during the Christmas holidays:

ANIMAL SENSES AND REACTIONS. *Dr. J. D. Carthy* (page 280)

XXXII. MEDALS FOR PAPERS

The Council have awarded Silver Medals for the Session 1959–60 to the following lecturers:

For Papers read at Ordinary Meetings

Sir Christopher Hinton and Sir William Holford. 'Power Production and Transmission in the Countryside: Preserving Amenities'
Dr. E. B. J. Postma. 'The Training of Staff for Foreign Posts: a Dutch Experiment'
Miss Helen Monro. 'The Art of Glass Engraving'
Christopher Cockerell. 'The Hovercraft and its Place in the Transport System'

For Papers read at Meetings of the Commonwealth Section

John Wilson. 'Blindness in the Commonwealth'
William Allan. 'Changing Patterns of African Land Use'

THE CHAIRMAN: I now invite questions or comments on the Report if any one present is so disposed.

There being no questions the Chairman continued:

Before I move the adoption of the Report, I should like to say a word on one or two aspects of it.

You have heard that during the course of the year we lost a number of valuable Members of Council and other Fellows of the Society. I should like to make a special reference to Sir Edward Crowe, who had so long and so variously served the Society. He had occupied almost every principal office, including that of President, and it was a great sadness to us to lose him in the early part of this year. We also suffered a great loss by the death of Colonel W. J. Brown of Canada who had for twenty years been Honorary Corresponding Member of the Society and was the first Fellow serving overseas in that capacity to become a Vice-President of the Society.

May I also refer to the generous gift from Mrs. E. M. Rich, which she made in memory of her late husband, and at his wish. Her benefaction of £500 will endow a lecture which we hope will worthily commemorate Edmund Rich and his services to the Society, particularly in the sphere of education.

Last July this meeting was presided over by the then Sir Alfred Bossom. In the course of the year he was honoured by being made a Life Peer, and we now know him as Lord Bossom of Maidstone in the County of Kent; I am sure you will wish to add your congratulations to the many he has already received.

In the course of the year several ventures recommended by the Future Policy Committee have been implemented. Perhaps the most important is the scheme of admission of industrial companies and trading bodies into association with the Society. Although this has only lately been instituted, we already can count over fifty of the leading companies in the country as associated with us—such as Associated Electrical Industries Ltd., Courtaulds Ltd., Imperial Chemical Industries Ltd., Rolls-Royce Ltd., to name only three or four. The Society has always been interested in the prosperity and well-being of British industry and in the application of science and art to that end, and we feel that this closer association will be of mutual advantage to us and these trading bodies.

You have heard of some of our newer activities: of our journey to Birmingham, for example, and our idea for bringing the provinces into closer touch with our work. The Birmingham meeting was very successful, with over fifty of the two hundred Fellows in the Midlands area present. They were enthusiastic about the prospect of arranging local meetings under the ægis of the Society from time to time. We are hoping perhaps to carry that idea further in other provincial centres.

Now that we have this enlarged house, we have felt we could perhaps go a little gayer than we have been in the past, and so we instituted the Annual Reception for Fellows and guests of the Society on 3rd March. We have also held the first of a series of small dinners so that Members of the Council may meet industrialists and artists and in an agreeable atmosphere may get to know each other's outlook.

We have now something over one hundred and forty Benjamin Franklin Fellows in America, and if you have read the lists of those gentlemen you will realize that they are very distinguished people in many walks of life. I think they will be an added strength to this Society, and I should particularly like to thank the American Committee whose work has made such a success of this scheme. Our Fellowship elsewhere has also increased; indeed, I think during this year we have attained a record number of Fellows.

The phenomenal growth of the Examinations Department has been referred to. That I think shows that our examinations are very much valued, especially in the commercial world. That is largely due, I am sure, to the admirable work done by our Examinations Department both in planning the examinations, and in most efficiently administering them, and also to the advice of our panel of examiners. Of course, the very success of the department is causing us some headaches, because we have to think about accommodation to meet the large growth that is taking place.

For the rest, as you will realize, our large premises, nearly two hundred years old, need quite a lot of attention to keep them in proper repair, and the Society is continually looking after that. Every year we hope to do something. The pictures above your heads have been cleaned since you were here last year, and we have laid a new oak floor in the library below.

From what you have heard, you will realize that this Society is in good shape, and I think now I might formally propose the adoption of the Report.

The motion that the Annual Report be adopted, having been formally seconded by Sir Ernest Goodale, was put to the meeting and carried unanimously.

The Chairman then called upon Mr. P. A. Le Neve Foster (acting in the absence of the Society's Treasurers) to move the adoption of the Accounts for the year ended 31st December, 1959.

MR. P. A. LE NEVE FOSTER: You have heard from the Chairman that the Treasurers are not able to be here, and therefore it falls to me, as a former Treasurer, to deal with the Accounts.

It is a matter of great satisfaction that the Accounts this year are I think the most satisfactory that have ever been presented in the long history of the Society. There is a surplus of £9,000, but that is not quite the whole story, because that surplus remains after the transfer of £5,000 to the Premises Purchase Fund Account. That brings me to my next point. As you have learned, under the terms of the lease of the premises next door the Society will be given the option to purchase those premises between the fourteenth and twenty-first years of its tenancy. The Treasurers are building up a fund for this purpose by setting aside each year £5,000, plus a portion of any surplus the Society may have on the year's working. This fund, as you will see from the Accounts, now stands at just over £21,000.

I do not think there are any other points of great interest which I need to mention.

I now formally move that the Accounts be adopted.

CAPTAIN STANLEY LAWRENCE, M.C.: I should like formally to second that motion, but before doing so may I be permitted to raise one item in the Accounts which interests me? I refer to the item for rates and insurance of £1,497. I presume the rates represent something like £1,000, which works out at approximately one-twentieth of the annual subscriptions received (£21,000). That means that one shilling in every pound annually subscribed to the Society goes to the Westminster City Council for rates. Well, in the light of the Scientific Societies Act—the Society having been granted the certificate prescribed for in that Act—I cannot understand how it is that we are even assessed, let alone called upon to pay rates, in respect of property used exclusively for the purpose of science. It is 'easy' money for the rating authority, an item which I, when a tithe-rate collector in the City of London until 1948, knew I should not insert in my Rate Book, let alone make a demand for the payment of it.

That is the point of interest to me, Mr. Chairman. Having expressed this view, I have much pleasure in seconding the motion.

THE CHAIRMAN: I am sure that we would all like to get the rates down: and we would wish for any help which you or any other person or body can give us for this purpose. Of course, we have consulted our legal advisers and a firm of rating consultants and we may well have done all that we can to reduce the rates. (I should perhaps observe that we pay no income tax.) But if you, Sir, feel that you have knowledge that we have not got, I am sure we should be very much obliged if you can advise us.

The motion that the Accounts be adopted was put to the meeting and carried unanimously.

THE CHAIRMAN: I should now like to thank the Treasurers for the admirable work that they have been doing over the year. With our increased activities their work too has considerably increased, particularly in connection with the Examinations Department, and the result, I think, speaks for itself. I would add that though our financial position this year is good, we have always got to bear in mind that we have to find a very large sum in the next ten to fifteen years for the purchase of the adjoining premises. Though we are building up something towards it, we must not think that we are entirely in clover yet—and if anybody is inclined to make benefactions, large or small, either now or in his will, it will help to relieve the Society of the anxiety which it may have in meeting the purchase of the freehold.

A FELLOW OF THE SOCIETY: Could you tell us how much we have got to pay for this building?

MR. LE NEVE FOSTER: £160,000.

The Chairman then called upon the Secretary to announce the New Council for

1960–61, *the list of which is as follows* (*names in italics are of Fellows who did not serve on the previous Council in the capacity indicated*):

PRESIDENT

His Royal Highness The Prince Philip, Duke of Edinburgh, K.G., K.T.

VICE-PRESIDENTS

Lord Bossom, LL.D., F.R.I.B.A.
Sir George Edwards, C.B.E. (President's nominee)
Sir Ernest Goodale, C.B.E., M.C.
Robert W. Holland, O.B.E., M.A., M.Sc., LL.D.
Sir Harry Lindsay, K.C.I.E., C.B.E.
Oswald P. Milne, F.R.I.B.A., J.P.
The Earl of Radnor, K.G., K.C.V.O.
E. Munro Runtz, F.R.I.C.S.
Professor R. Y. Gooden, C.B.E., A.R.I.B.A., F.S.I.A. (Master of the Faculty of R.D.I.)
Professor Simon Lissim (*Senior Honorary Corresponding Member in the United States*)

ORDINARY MEMBERS

Mrs. Mary Adams, O.B.E., M.Sc.
Sir Hilary Blood, G.B.E., K.C.M.G.
The Honble. G. C. H. Chubb, M.A.
Lord Conesford, Q.C.
R. E. Dangerfield
Geoffrey de Freitas, M.A., M.P.
Professor Sir Charles Dodds, M.V.O., D.Sc., M.D., Ph.D., F.R.C.P., F.R.S.
E. Maxwell Fry, C.B.E., B.Arch., F.R.I.B.A.
Peter A. Le Neve Foster
John Gloag, Hon.A.R.I.B.A., Hon.F.S.I.A.
Stanley E. F. Gooding, M.A., M.Sc., M.D., J.P.
Milner Gray, R.D.I., PP.S.I.A.
J. C. Jones, C.B.E., B.Sc., M.I.Mech.E., A.M.I.C.E.
Edgar E. Lawley
Lord Nathan, P.C,. T.D., P.R.G.S., F.B.A., F.S.A.
Lord Netherthorpe
Paul Reilly
Sir Gilbert Rennie, G.B.E., K.C.M.G., M.C.
A. R. N. Roberts
Sir Philip Southwell, C.B.E., M.C.
Professor S. Tolansky, Ph.D., D.Sc., F.R.S.
C. M. Vignoles, C.B.E., M.A.
Hugh A. Warren, M.Sc.(Eng.), M.I.C.E., M.I.Strut.E.
Miss Anna Zinkeisen, R.O.I., R.D.I.

TREASURERS

F. A. Mercer, Hon.F.S.I.A.
G. E. Tonge, C.B.E.

THE CHAIRMAN: I seem to have done a great deal of talking this afternoon, but I feel that I cannot let you go away without proposing what I think is the most important vote of thanks this afternoon, and that is to our staff. For it is the staff that makes the affairs of this Society run so smoothly. The staff led by Dr. Luckhurst (and he tells me that to-day is the twenty-fifth anniversary of his joining the staff of the Society) deal with everything most efficiently. He himself has to keep the Chairman in order and everything else running, and he does it in a very tactful and charming way. The staff not only meet every call that we put upon them, but they have lots of initiative. We often get quite valuable suggestions

from members of the staff for the good of this Society. Though I would like to mention them all by name, I shall single out Mr. Wheeler. He and his staff of the Examinations Department have done an excellent job of work. They have met every call, and sometimes under pressure and difficulties. It is only by their most excellent and efficient work that things have run as well as they have. And I should also like to refer to Mr. Nicholls of the Printing Department, because he also has taken the expansion of the examination work in his stride. Both these departments have met every call upon them without fail.

I propose a vote of thanks to all the members of the staff.

The vote of thanks was carried with acclamation, and was acknowledged briefly by the Secretary.

THE EARL OF RADNOR, K.G., K.C.V.O.: I am privileged to propose one other vote of thanks—to our Chairman, not only for the work that he has done in taking the Chair to-day but for the work he has done as Chairman of the Society. Mr. Milne mentioned the name of the late Sir Edward Crowe. He was responsible for inveigling me into becoming Chairman of this Society for one year on the plea that there was not much work to do. Well, I learnt by bitter experience (not for the first time) that such pleas are misleading, and that a great deal, unseen by the ordinary person, is involved in being Chairman of this Society. Mr. Milne also said that one of the Secretary's duties was to keep the Chairman in order. It is the Chairman's duty to be available to the Secretary whenever he wants advice, and I think in respect of both the multitude of work which comes to the Chairman behind the scenes and in the support which he gives to the Secretary, Mr. Milne has done the job extraordinarily well, and deserves the most sincere thanks of the Society.

The vote of thanks to the Chairman was carried with acclamation.

There being no other business, the meeting then ended.

ENERGY

Three Cantor Lectures

I. THE GENERATION OF POWER

by

J. M. KAY, M.A., Ph.D., M.I.Mech.E.,

Professor of Nuclear Power,
Imperial College of Science and Technology

Monday, 9th May, 1960

INTRODUCTION

In the first of his three Cantor lectures on the fuel and power industries, Dr. Albert Parker surveyed world energy resources and analysed the demand for fuel and power. He discussed in particular the world energy resources of the fossil fuels: coals and lignites, petroleum, and natural gas, etc. In Table VI of his paper he gave figures for the world consumption of fuel and energy in 1958, expressed in terms of the equivalent quantity of bituminous coal. Coal and lignite represented 46·1 per cent of world fuel consumption, petroleum came second at 29·7 per cent, and natural gas third at 11 per cent, while water power accounted for 5·5 per cent of the total. Figures for the national fuel and energy consumption within the United Kingdom are given in Table VII of Dr. Parker's paper. In the year 1958 the actual consumption of primary fuel in Britain, expressed in million tons of coal equivalent, was made up as follows:

Coal	...	...	...	198·9	million tons
Oil	...	...	...	47·6	
Hydro-electricity			...	1·4	

The object of the present lecture is to review the methods of generating *electric power* on a large scale from these primary energy sources. The two subsequent lectures, by Mr. F. H. S. Brown and Mr. C. R. King, will describe the power and transmission system in the United Kingdom and the retail distribution of electricity.

It is important to appreciate that the major part of the present world consumption of fuel is used for the generation of heat for industry and domestic use, and for the large number of relatively small stationary and mobile power units. The total world proportion of the primary fuel consumed in 1958 which was used for the generation of electricity in central stations was less than 10 per cent. In the United Kingdom, however, the proportion is higher and the fuel requirements of the Central Electricity Generating Board alone accounted for nearly 20 per cent of the total national fuel consumption in 1958. A similar situation exists in other highly industrialized countries. Furthermore, the demand for electric power is rising rapidly in all parts of the world, a typical figure for the rate of growth being 7 or 8 per cent per annum. It may confidently

be predicted that electric power generation will in future account for an increasing proportion of the total world use of primary fuel.

At the present time there are two main methods of generating electric power on a large scale from the primary energy resources. Water power, although representing a relatively small proportion of the total world energy consumption, is a major source of electric power generation. About one-third of all the electricity generated in the world at the present time comes from hydro-electric plant. In many countries water power accounts for the major part of the electrical generating capacity, for example Norway, Sweden, Canada, and Brazil. Water power has the special merit that it represents living on income, and not on capital, so far as the energy resources of the world are concerned.

The second method of large-scale electric power generation is by the use of thermal power stations burning the fossil fuels coal and oil. In those countries which do not have large resources of water power suitable for economic development, thermal power stations are necessarily the main method of electricity generation. This is particularly true of the United Kingdom.

A third source of power has of course been developed during the past decade and promises to play a significant rôle in the future. Nuclear energy released as a result of the fission of certain isotopes of the heavy elements, particularly uranium 235, can be used as a source of heat for electric power generation. Nuclear power stations are contributing only a very small proportion of electrical generating capacity at the present moment, but within a few years the contribution will be a significant one.

It will be convenient in this paper to take the two basic methods of power generation in turn and to review some of the engineering techniques and problems. It must be emphasized that this is a very wide field to cover in one lecture. It will only be possible to consider the most important types of plant employed. The survey must be restricted to generation on a large scale, and preference will be given to current trends in power plant design in Britain.

HYDRO-ELECTRIC POWER GENERATION

In those countries where favourable geographical conditions exist, water power provides the cheapest source of electricity. Hydro-electric schemes constructed in different parts of the world cover a very wide range of operating characteristics, power output, and engineering design features. They may be classified broadly under the following headings:

(1) Low head run-of-river schemes,
(2) Low and medium head storage schemes with large catchment areas,
(3) High head storage schemes.

Low head run-of-river schemes are normally operated for base load generation at high load-factor, although there may be a large seasonal variation for example with glacier-fed rivers and in territory where there is a large seasonal variation in rainfall. With favourable site conditions the civil engineering cost of a run-of-river scheme will generally be less than that of a scheme requiring large storage works. The type of prime mover employed in a low-head scheme is normally

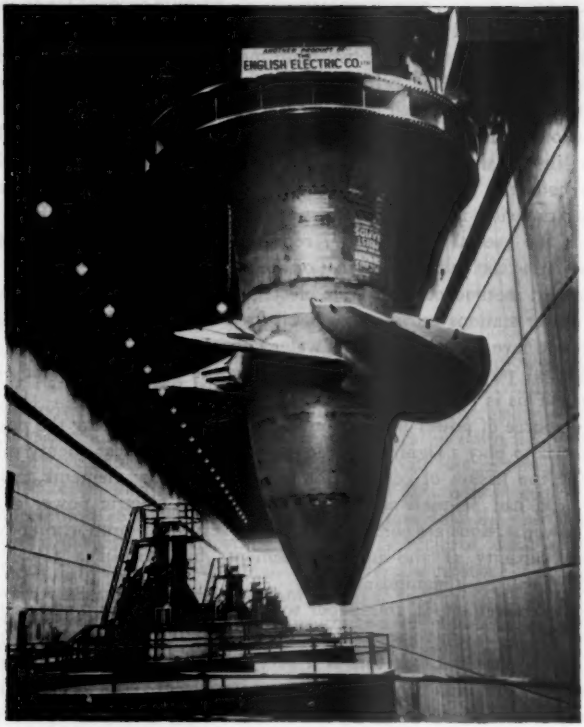

FIGURE 1. *Kaplan turbine runner*

the axial-flow, variable-pitch, *Kaplan turbine*. Figure 1 shows the runner of one of the ten Kaplan turbines at present being erected at the Priest Rapids power station in the United States. The head range is from 33 to 84 ft., and the maximum output of each turbine is 131,000 b.h.p. at a speed of 87·7 r.p.m. The runner diameter is 23 ft. 8 in. These turbines, which were designed and constructed by the English Electric Company, are the largest in physical dimensions so far built in Britain.

If firm power is to be provided at all times from a hydro-electric installation in territory where there is a large variation in the run-off, storage must be provided and a sufficient volume of water must be impounded by means of a dam so that the maximum variation between supply and demand can be catered for. Large storage schemes employing medium or high heads may be extremely attractive where the geographical features are favourable. This applies in many parts of the world, including important areas of both North and South America, and many countries of Western Europe.

FIGURE 2. *Francis turbine runner*

The type of turbine most frequently employed for medium-head schemes is the radial-flow *Francis turbine*. Figure 2 shows the runner of a Francis turbine manufactured in this country for a power station in India. This particular machine operates under a maximum head of 250 ft., and generates 77,000 b.h.p. at a speed of 150 r.p.m. One of the most significant developments in hydro-electric power engineering in recent years has been the design of Francis-type reaction turbines for successively higher heads. Figure 3 shows a cross-section through a high-head Francis turbine designed by the English Electric Company for installation in the Bersimis power station in Quebec. These machines operate under a maximum head of 875 ft. and each turbine has a rated output of 175,000 b.h.p. at a speed of 277 r.p.m.

For very high head schemes, however, an *impulse machine* must be employed. This type of turbine is usually known as a Pelton wheel. A typical example may be quoted of a machine of this type constructed for the Vila Nova station in

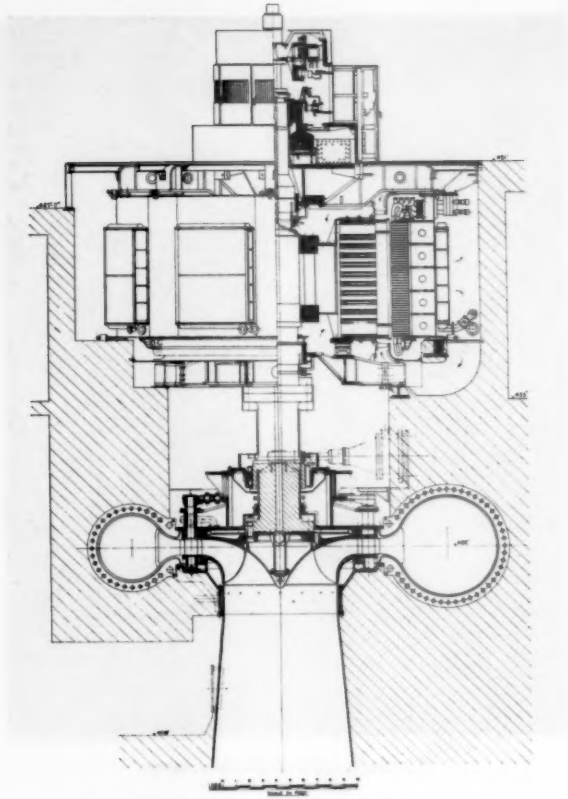

FIGURE 3. *Section through high-head Francis turbine*

Portugal. This particular design of turbine, which operates under a net head of 1,300 ft., has twin overhung runners and four jets. The maximum output is 44,500 b.h.p. at a speed of 428 r.p.m. Pelton wheels have been built for operation at heads of up to 6,000 ft.

The classification of water turbine duty should strictly be on the basis of *specific speed* rather than simply on the maximum head. The specific speed N_S is defined by $N_S = \frac{N\ P^{1/2}}{H^{5/4}}$

where N is the actual rotational speed in r.p.m.,
P is the power output in b.h.p.,
and H is the head in feet.

The characteristics of the four turbines referred to above may be summarized in the following table:

STATION	*Priest Rapids*	*Rihand*	*Bersimis*	*Vila Nova*
TYPE	*Kaplan*	*Francis*	*Francis*	*Impulse (4 jet)*
P b.h.p.	131,000	77,000	175,000	44,500
H ft.	84	250	875	1,300
N r.p.m.	87·7	150	277	428
N_S	125	42	24·3	11·6

It will be observed that these four representative designs cover an ascending range of head corresponding to a descending scale of specific speed. Progress in water turbine design in recent years has consisted largely in extending the Kaplan type into the medium-head range (specific speeds down to about 80), and in extending the Francis turbine into the high-head range (specific speeds down to about 20).

Although in Western Europe as a whole water power represents the major source of electrical energy—for example in Norway it accounts for 99 per cent, in Sweden 95 per cent, and in France about 50 per cent of the installed capacity—in the United Kingdom it makes a much smaller contribution. This is not to discount the importance, however, of the North of Scotland Hydro-Electric Board which now has an installed capacity of hydro plant in operation amounting to 866 MW, while another 582 MW of plant is at present under construction. In the Highlands of Scotland the possibilities for hydro-electric power are effectively confined to medium head storage schemes of relatively small individual size. A relatively large capital cost is involved on the civil engineering side with schemes of this type, but the cost per kilowatt installed can be reduced by increasing the installed capacity of the turbo-generator plant in relation to the available catchment area and annual run-off. In these conditions the hydro-stations are operated at a relatively low load-factor. In addition to providing the demands of the North of Scotland area, which would involve operating at the system load factor, they also make a useful contribution in supplying peak-load power to the central industrial region of Scotland. A good example of this type of peak-load hydro station is represented by Loch Sloy, which has an installed plant capacity of 130 MW with four Francis-type turbines operating under a maximum head of 910 ft. This station operates at a load factor of about 10 per cent and supplies peak load power to the Glasgow area. Loch Sloy has the largest installed capacity of any of the N.S.H.E.B. stations, although Fasnakyle with 66 MW installed capacity produces the greatest number of kilowatt-hours. Two other stations may be picked out for special mention on grounds of technical interest: Finlarig with one impulse-type turbine of 30 MW has the highest gross head of

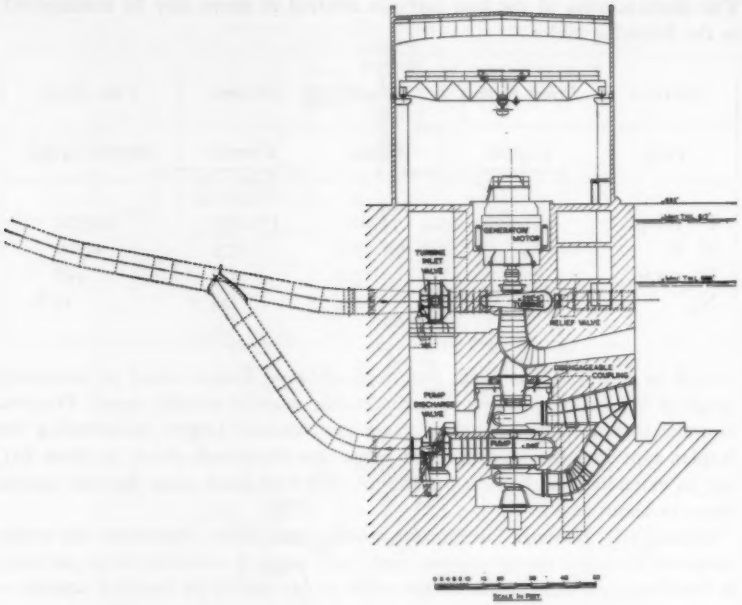

FIGURE 4. *Section through the Ffestiniog pumped-storage plant*

1,362 ft., while Invergarry with one Kaplan turbine of 20 MW operates under a head of 175 ft., which is the highest yet used for a Kaplan machine in Britain.

There is another important possibility, however, for hydro-power in Britain, although not as a primary source of energy. Water may be used as a means of energy storage. At Ffestiniog in North Wales a large pumped-storage scheme is being installed by the Central Electricity Generating Board. In this scheme water will be pumped up from the lower to the upper reservoir at off-peak periods during the night, while power will be generated at the Ffestiniog station at periods of peak-load demand by using water from the upper reservoir to drive the turbines. A section through the Ffestiniog plant is shown in Figure 4. It will be seen that a single electrical machine functions both as generator and as a synchronous motor, while separate hydraulic machines are provided on the same shaft acting as turbine and pump respectively. The turbine is permanently coupled to the generator, while the pump is engaged mechanically during the pumping period of the cycle. This station will operate on a daily cycle, and a typical arrangement would be pumping for six hours during the night and generating for about four hours at peak-load periods during the morning and evening. The installed capacity of the Ffestiniog station, with four identical units, will be 300 MW. Another large pumped-storage scheme is to be built by the North of Scotland Hydro-Electric Board at Loch Awe and will be used

for supplying peak-load power to the South of Scotland Electricity Board. This station will have an installed capacity of 400 MW and will operate with a gross head of 1,177 ft.

THERMAL POWER STATIONS

In the United Kingdom thermal power stations account for more than 96 per cent of the installed generating capacity of the three nationalized electricity generating boards (C.E.G.B., S.S.E.B., and N.S.H.E.B.). At 31st March, 1959, the total installed generating capacity of the steam plant operated by the C.E.G.B. amounted to 25,200 MW. The great majority of the C.E.G.B. stations are coal burning. Some stations are adapted for burning either coal or oil, but at 31st March, 1959, there were seven large stations using only oil as fuel having a total installed plant capacity of 1730 MW. Some 2000 MW of new generating plant must be built every year to meet the growing demand for electricity and to replace obsolete plant. Further information about the C.E.G.B. system will be given in Mr. Brown's lecture.

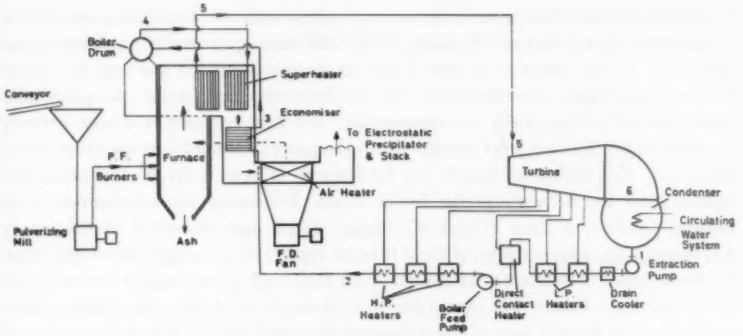

FIGURE 5. *Flow diagram for thermal power station*

At the end of the War in 1945 there was a serious shortage of generating plant. In order to accelerate the construction of new generating stations, the plant programmed for commissioning up to 1954 was almost exclusively of two standard types: 30 MW units with turbine stop valve conditions of 600 p.s.i. and 850°F., and 60 MW units with turbine stop valve conditions of 900 p.s.i. and 900°F.

Although technical interest normally tends to concentrate on the turbine generator unit, a modern thermal power station is actually a complex processing plant in which the primary fuel, coal or oil, is processed to yield electrical energy. A typical arrangement of the main components comprising a thermal power plant is shown in Figure 5. This is a simplified flow diagram showing the interrelation of the three main circuits: the fuel and combustion circuit, the steam and water circuit, and the cooling system.

A typical fuel and combustion circuit can be outlined as follows. Small coal, transported by sea or rail, is unloaded at the power station site and is supplied

by a conveyor system to hoppers feeding the pulverizing mills. A typical large power station of 600 MW installed capacity operating on base load at 75 per cent load factor would consume nearly two million tons of coal a year, so that fuel handling itself involves a major engineering installation. From the pulverizing mills the fuel is delivered to horizontal burners located in the wall of the boiler plant furnace. Ash or slag falls to the bottom of the furnace and is removed as a waste product. Surrounding the furnace are water-cooled tubes forming the evaporative section of the boiler. With the steady increase in steam pressures, however, the heat of evaporation becomes a smaller and smaller part of the total heat load in the boiler, with the result that it is increasingly difficult to surround the furnace entirely with water-cooled tubes. Some of the radiant heating surface in a modern boiler must therefore be provided by the superheater.

At exit from the top of the furnace following the radiant section of the superheater, the hot gases pass across banks of superheater tubes comprising the convective section of the superheater. As the name implies, heat transfer in this region is mainly by convection, although radiation from the hot gases still plays a significant part. The superheater of a modern boiler is a complex installation comprising many banks of tubes with different geometrical arrangements. This part of the boiler is in fact a heat exchanger with the gas and the steam flowing essentially in counter flow. On exit from the superheater, the gases have been reduced substantially in temperature, and heat transfer is almost entirely by convection. Further heat transfer from the gases is obtained in the economizer section of the boiler, in which the feed water is heated up to the saturation temperature for delivery to the boiler drum. Following the economizer, it is normal practice to have a large air heater which may be either of the rotary Ljungstrom or, alternatively, of fixed tubular type. The air supply for combustion in the furnace is delivered by forced draft fans and is pre-heated before entry to the furnace. Finally the cool gases pass through an electrostatic precipitator, to remove the greater part of the entrained dust and smoke, before being passed to the stack.

The water and steam circuit can also be traced out by reference to Figure 5. Condensate from the main condenser (point 1 on the diagram) is removed by the extraction pump and passes through the feed train. In this section of the plant the water is heated up to the feed temperature by means of bled steam tapped off from the turbine at intermediate points. Tracing through the main items of plant in succession, it is normal to have first a drain cooler followed by two or three low-pressure heaters. In the diagram the third of these heaters is of the direct contact type and it acts as a de-aerator for the feed water. Following the de-aerator we have the main boiler feed pump which raises the pressure of the water to the maximum value for delivery to the boiler. This pump is a large multi-stage centrifugal machine which may be driven either by an electric motor or by an auxiliary steam turbine. From the boiler feed pump the water passes through the high-pressure feed heaters which again are heated by means of bled steam tapped off from the turbine. At the end of the feed train we have reached point 2 on the diagram and, if we take figures appropriate to a large modern set of

100 MW capacity, a typical final feed temperature would be about 400°F. The hot water now enters the boiler plant and passes through the economizer where it is raised to the saturation temperature, which for a 100 MW plant with 1500 p.s.i. working pressure would be 597°F. We are now at point 3 on the diagram and the water has reached the boiler drum.

The water, now at its boiling point, next circulates through the evaporator section of the boiler. Normally, natural circulation is employed and the flow of water through the vertical evaporator tubes is maintained by the changes in density due to heating and the formation of steam in the tubes. Down-comers from the boiler drum take the water to headers at the bottom of the evaporator tubes, and the water flows up the tubes which surround the furnace of the boiler. The water-steam mixture at the saturation temperature passes from the top of the evaporator back to the boiler drum. In some boiler designs assisted or forced circulation may be employed. Saturated steam is drawn off from the boiler drum and baffles are located inside the drum to achieve the greatest possible degree of separation of entrained drops of water. We have now reached point 4 on the diagram, and the saturated steam enters the low temperature end of the superheater. The steam passes successively through the various banks of tubing

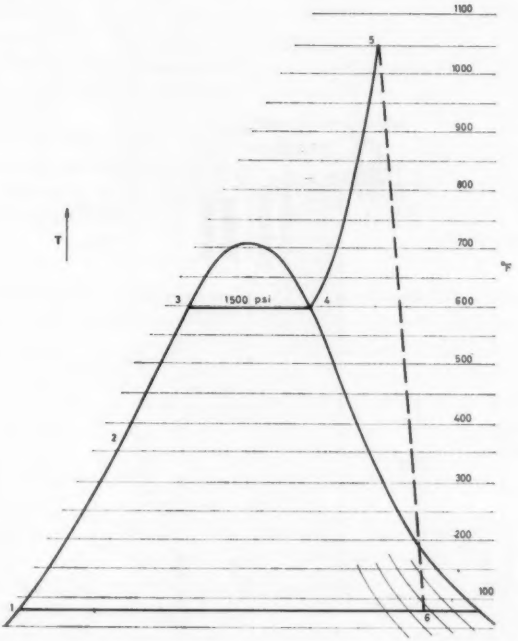

FIGURE 6. *Temperature-entropy diagram for 100 MW steam turbine*

which make up the superheater, finally leaving the radiant section of the superheater at the maximum steam temperature. The superheated steam (point 5 on the diagram) is now delivered through the high-pressure steam main to the turbine inlet. In the turbine the steam is expanded from the delivery pressure and temperature (1500 p.s.i., 1050°F.) down to the condenser pressure. The pressure in the condenser may be as low as 1″ of mercury absolute or 28·9″ vacuum, the corresponding temperature in this case being 80°F.

If reference is now made to Figure 6, the cycle of operations for the water and steam circuit is shown in the form of a temperature-entropy diagram. The numbered points correspond to those indicated on the flow diagram of the previous Figure. Flow through the feed heating train is represented by the section 1–2, heating in the economizer is represented by the curve from 2–3, evaporation takes place along the horizontal line 3–4, superheating takes place along a (nearly) constant pressure line from 4–5. Expansion through the turbine is represented by the dotted line 5–6, and finally condensation of the exhaust steam in the condenser is represented by the horizontal line 6–1.

The latent heat of condensation is removed by means of the circulating water system. In the case of a coastal site, or where an unrestricted supply of river water is available, direct cooling of the condensers may be employed using sea

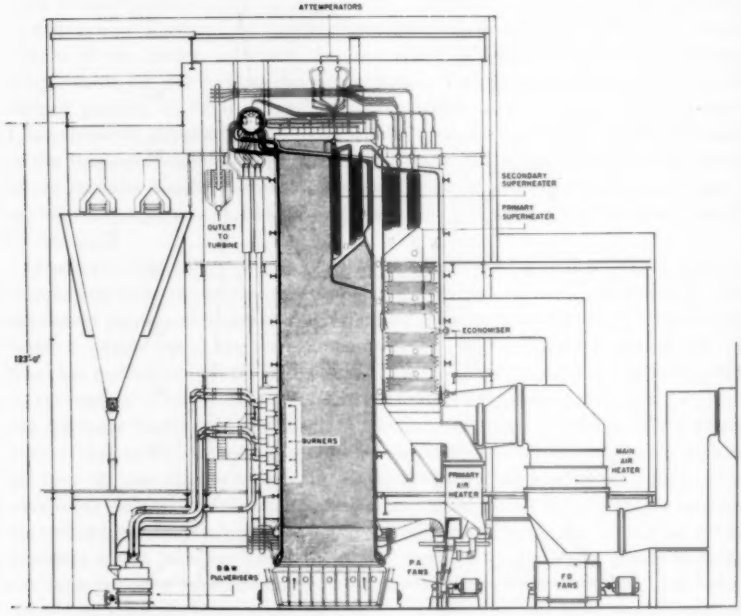

FIGURE 7. *Section through the Castle Donington boiler*

water or river water. For most inland sites, however, it is necessary to employ a cooling tower system. The cooling water leaving the condensers is circulated to the cooling towers where heat is rejected to the atmosphere by partial evaporation of the water. Make-up water must be provided from a river or from some other suitable source. Even with a cooling tower system the water requirements for cooling purposes are considerable, and the availability of cooling water is one of the major factors which determine the choice of suitable sites for thermal power stations. An interesting experiment is being carried out at the present time with the construction of a prototype dry cooling tower at the C.E.G.B. station at Rugeley. In this scheme heat is rejected to the atmosphere using air alone as the final heat transfer medium.

Figures for the temperatures, pressures, and heat quantities, for the standard post-war 60 MW and 100 MW turbo-generator sets are summarized in Table I below:

TABLE I

	Non-re-heat plants	
Output of set	60 MW	100 MW
Steam pressure p.s.i.g.	900	1,500
Steam temperature °F.	900	1,050
Boiler capacity lb/hr.	550,000	830,000
Final feed temperature °F.	375	410
Economizer heat (H_3–H_2)	181	227
Evaporator heat (H_4–H_3)	666	554
Superheat (H_5–H_4)	256	352
Number of feed heating stages	5	6
Thermal efficiency (excluding auxiliaries)	37·4%	40·4%
Net thermal efficiency of steam plant ...	36·5%	39·3%
Overall thermal efficiency	30·4%	33·0%
	(Marchwood)	(Castle Donington)

It may be of interest to look at some of the individual items of plant which have been mentioned in the above description of a typical thermal power station. Figure 7 is a drawing of one of the Babcock & Wilcox 100 MW boiler units at Castle Donington. Figure 8 shows a section through one of the 100 MW A.E.I. turbines. Figure 9 shows a general view of the turbine hall at Castle Donington with the six 100 MW turbo-generator sets. This station has held the record for the highest thermal efficiency in Britain for some two or three years. It represents the present state of development of the straight non-reheat cycle with steam conditions of 1500 p.s.i.g. and 1050°F.

It is normal practice in modern power station design to choose the one-boiler one-turbine unit system, and the 100 MW units working on the straight non-re-heat cycle described above represent the culmination of the immediate post-war period in generating plant design. It will be appreciated that there are strong economic incentives to develop larger units and to achieve higher thermal efficiencies with more advanced steam conditions. It is important, however, to

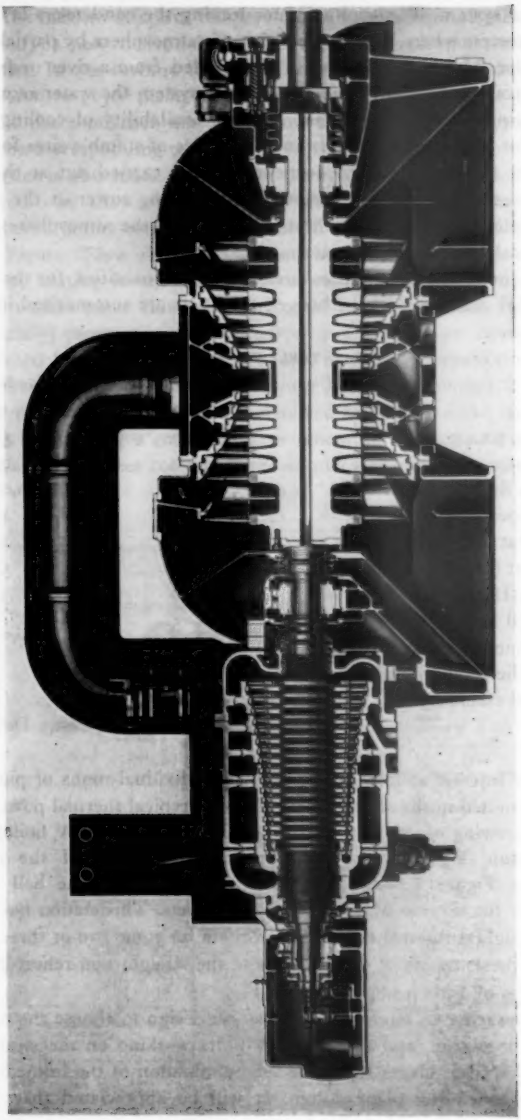

FIGURE 8. *Section through A.E.I. 100 MW turbine*

FIGURE 9. *Turbine hall at Castle Donington*

take note of the practical limitations which influence the choice of pressure and temperature and also determine the maximum feasible size of plant. With regard to the steam turbine itself, it should be mentioned that increase of size or power output goes hand in hand with the use of more advanced steam conditions. There are two problems which should be noted in particular. First, the problems of design at the high pressure end of the turbine, where the temperatures and pressure involved necessitate the use of a double-casing construction for the high-pressure cylinder and where special difficulties are encountered in the choice of materials capable of withstanding high stresses at elevated temperatures. A quite different design problem arises at the low pressure end of the machine, where the difficulty consists of handling the very large volume-flow of exhaust steam with a minimum energy loss. The design of very large turbines has necessitated the development of longer blades for use at the exhaust end. For turbines having a power output greater than 120 MW it is normally necessary to employ three or more exhausts.

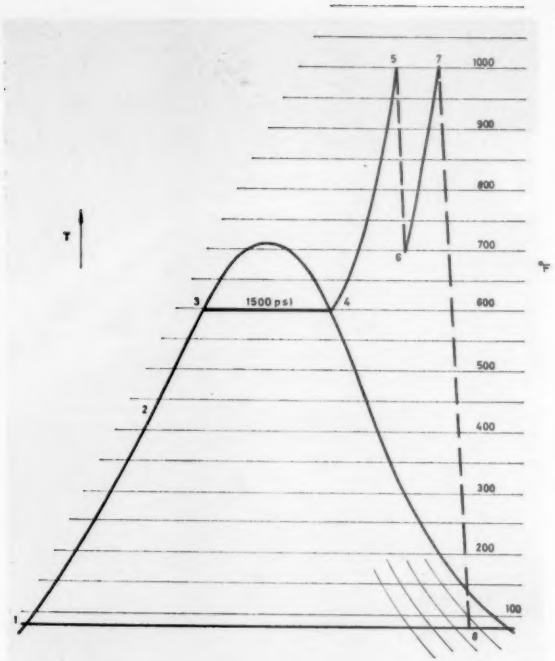

FIGURE 10. *Temperature-entropy diagram for 120 MW re-heat turbine*

Another limiting feature in the development of larger generating units is that of the alternator, in particular the size and weight of the alternator stator. In many countries there is a limitation on the permissible load that can be transported, and a figure of 150 tons has been accepted up to now as the maximum weight for the alternator stator. Development of alternator design to cater for increased output has been possible, however, without a proportionate increase of size and weight by improving the method of cooling. Hydrogen cooling of the alternator has been introduced in recent years and has now become normal practice. A further development which has now been carried to the prototype stage involves the use of water cooling for the stator.

With regard to steam conditions, a temperature of 1050°F. represents the present upper limit so far as normal practice is concerned. Great difficulties are encountered with materials at the high temperature end of the turbine if higher temperatures are used, although a few sets have been built for temperatures of 1100°F., or even higher. An important development is the introduction of *re-heating*. A typical re-heat cycle is shown on Figure 10 in the form of a temperature entropy diagram. Re-heating is employed in the standard 120 MW sets

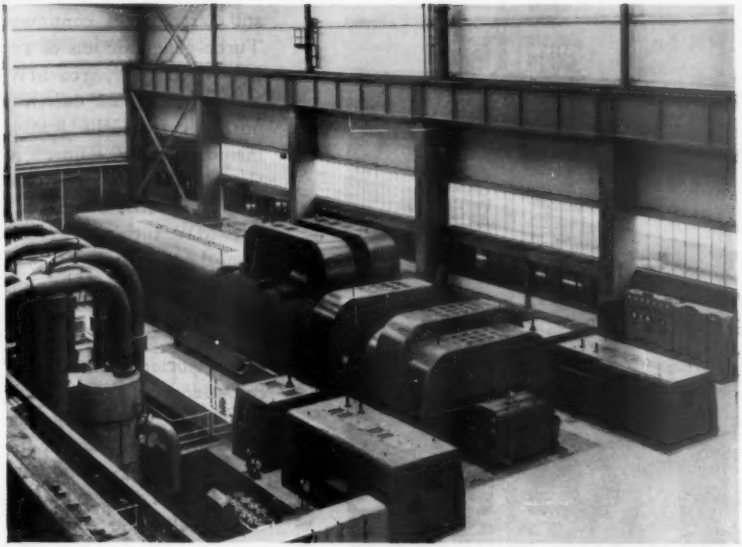

FIGURE 11. *200 MW turbo-generator plant at High Marnham*

which are now being installed at a number of power stations in Britain. The temperatures and pressures shown on Figure 10 correspond to one of these sets, the initial steam conditions being 1500 p.s.i.g. and 1000°F., and the steam is returned to the boiler after expansion through the high-pressure cylinder of the turbine where it is re-heated to the same maximum temperature of 1000°F.

Advancing from the 120 MW size, the next step forward is to a machine of 200 MW using initial steam conditions of 2300 p.s.i.g. and 1050°F., re-heating to 1000°F. Figure 11 shows a photograph of the first 200 MW re-heat set to go into operation in this country at High Marnham. This machine was designed and built by the English Electric Company, and the boiler installation in this case has been supplied by International Combustion Ltd. Figure 12 shows one of the A.E.I. sets now under construction for Willington 'B' power station. These sets will have initial steam conditions of 2350 p.s.i.g. and 1050°F. re-heating to 1000°F. Figure 13 shows a general arrangement of one of the Babcock & Wilcox 200 MW boiler units for Willington 'B'. A number of other 200 MW sets are on order at the present time, for example, two Parsons sets for the C.E.G.B. station at West Thurrock and two G.E.C. sets for the Kincardine station of the S.S.E.B. Table II gives typical figures for steam, conditions, etc., for 120 MW and 200 MW re-heat plants.

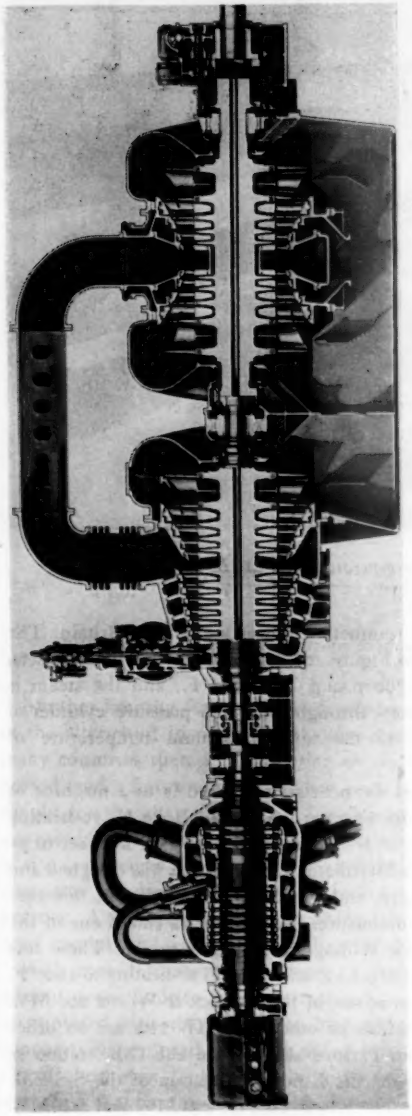

FIGURE 12. *Section through A.E.I. 200 MW steam turbine*

The development towards still larger sizes continues. Turbo-generator sets of 275 MW, 300 MW, 350 MW, and 550 MW are currently on order from the leading manufacturers. Figure 14 shows a section through the English Electric design for a 275 MW turbine. In this case the development of a new exhaust blade of 36″ length has made it possible to achieve a design with a more efficient low-pressure end. Mention should be made also of the A.E.I. design for a 300 MW machine for the West Thurrock power station. In each of these designs the initial steam conditions are 2300 p.s.i.g. and 1050°F., re-heating to 1050°F.

It is most important to note that the increase of power output from the 30 MW sets of the immediate post-war years up to the single-shaft 275 and 300 MW sets and twin-shaft 550 MW sets has been achieved without a proportionate increase in physical dimensions. Still more important from the economic point of view, the cost per kilowatt ins talled fo the larger sizes is appreciably less than that of the earlier 30 and 60 MW sets. The fact that the cost of electric power generation is remaining substantially constant in spite of increased fuel and transport costs, is

TABLE II

	Re-heat Plants	
Output of set	120 MW	200 MW
Steam pressure p.s.i.g.	1,500	2300
Steam temperature °F.	1000	1050
Boiler capacity lb/hr.	860,000	1,400,000
Final feed temperature °F.	435	460
Economizer heat (H_3–H_2)	200	267
Evaporator heat (H_4–H_3)	554	401
Superheat (H_5–H_4)	323	388
Re-heat (H_7–H_6)	162	176
Re-heater outlet pressure p.s.i.g. ...	404	441
Re-heater outlet temperature °F. ...	1000	1000
Number of feed heating stages	6	6
Thermal efficiency (excluding auxiliaries)	41·6%	44·2%
Net thermal efficiency of steam plant ...	40·5%	42·9%
Overall thermal efficiency (estimated) ...	35% (approx.)	37% (approx.)

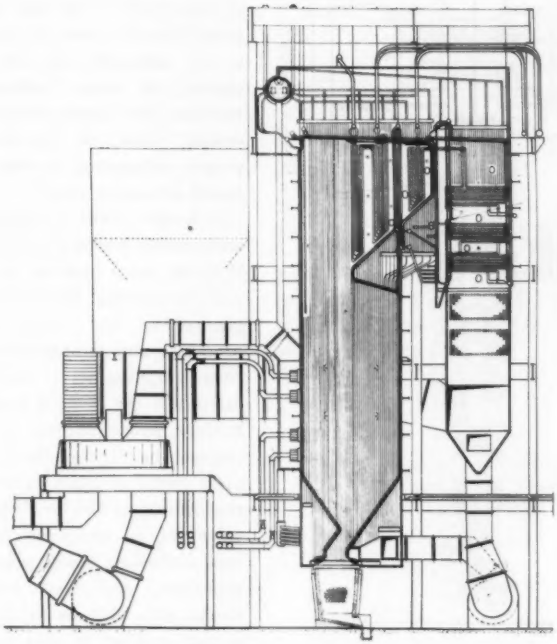

FIGURE 13. *Arrangement of Babcock & Wilcox 200 MW boiler*

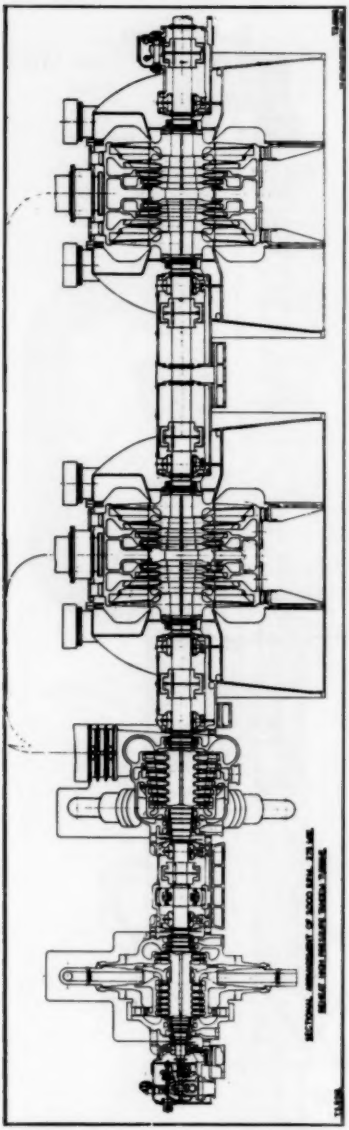

FIGURE 14. *Section through English Electric 275 MW steam turbines*

largely due to the great strides in engineering design that have been possible during the last decade and particularly the successful development of these new units of very large individual output capacity. This is, rather curiously, an engineering achievement which has not been widely recognized and has not caught the public imagination. While other less important developments, for example gas turbines, have been hailed as major achievements, the steam turbine has been largely ignored in most university engineering departments in recent years, with the consequence that young graduate engineers have an altogether false impression of what is important in the field of power generation. It is time for the balance to be redressed and for the designers of steam boilers, steam turbines, and heavy electrical generating plant, to be given their proper recognition for the achievements of recent years.

A further point of importance in engineering design should be noted. With the great increase in the output of individual boilers and turbogenerators, and with advancing pressures and temperatures, it becomes increasingly necessary to carry out the overall design of a modern power station as a single engineering concept. Even the auxiliary items of plant present major engineering problems. The capital value of a complete 550 MW unit, including boiler plant, turbogenerator, and civil engineering works, etc., will be in the region of £22 million to £25 million. A very large outlay on the design and development of all the individual com-

ponents for a plant of this magnitude is justifiable to ensure reliable and efficient operation.

Acknowledgements

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II. THE POWER SYSTEM

by

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Monday, 16th May, 1960

The provision of a supply of electricity has become a hall-mark of civilization. The statistics of the consumption of electricity from the mains are increasingly being taken as the yardstick by which the degree of industrialization of a country is measured, and are also to a large extent indicative of its standard of living. The Electricity Supply Industry is complex, however, and a main difficulty in a lecture of this type is to present in logical array all the relevant but separate factors which together explain why the public supply system has taken its present form and is evolving as it is. The lecture will therefore range over a fairly wide field, but this is inevitable for even an outline picture of the system for the generation and main transmission of electrical power in this country.

From the point of view of the supplier, electricity may be said to have three main characteristics.

Firstly, it cannot be stored and has therefore to be generated to match exactly the demand imposed by the consumer, over which the supplier has little or no control. This demand varies not only from hour to hour during the day and from day to day during the week, but also varies from month to month during the year, and Figure 1 shows recent typical load curves for a weekday and weekend in (1) summer and (2) winter in this country. It will be seen, as might be expected, that the load during the day is higher than during the night, and during winter is higher than during summer. The important point is that the capacity of the generating plant available must be capable of meeting the highest instantaneous demand imposed by all the consumers at any time. It is thus obvious that much of the plant installed will be standing idle for a significant part of its life, and this is a matter of considerable importance in designing the system. At this juncture it will suffice to observe that the total demand can be divided into two component parts. One of these, known as the base load—line A–B on Figure 1—can be regarded as more or less steady throughout the year; superimposed upon it is the other component—known as the peak load—which varies from zero to a maximum according to the demand of the consumers.

The second characteristic is the continuous increase in demand for electricity. This increase is surprisingly consistent as is shown on Figure 2, which plots the peak demand upon the British system (excluding Scotland) over the past thirty years on semi-logarithmic graph paper. It will be seen that the points lie close to a mean straight line which corresponds to an annual rate of increase of 7.0 per cent per annum compound interest, which is equivalent to a doubling

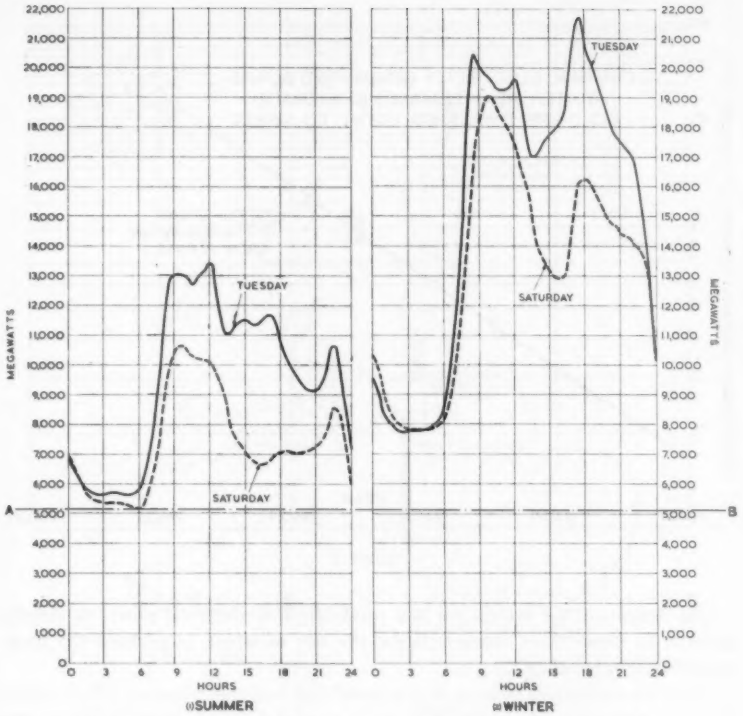

FIGURE 1. *Typical daily load curves, summer and winter 1959–60*

in demand about every ten years. This rate of increase in this country is not abnormal and very similar figures are shown in the majority of civilized countries, including even the most highly industrialized country in the world, the United States of America, and some under-developed countries show even higher rates of increase. This substantial rate of load increase entails an equally substantial rate of installation of new plant, and this means that the base load and that part of the peak load which persists for a large part of the day, in other words the larger proportion of the total energy requirements, can be generated on modern plant, leaving only the smaller proportion to be generated on ageing and relatively inefficient plant. This puts a premium on the advancement of technical efficiency.

A third characteristic of the industry, which is more specifically confined to this country, is that since our hydro-electric resources are relatively small, almost all generation of electricity involves the use of fuel of one sort or another, and the electrical generating industry is therefore basically a fuel-processing industry. Professor Kay, in his earlier lecture in this series, will have described to you the various ways in which the raw fuel is processed into electrical power.

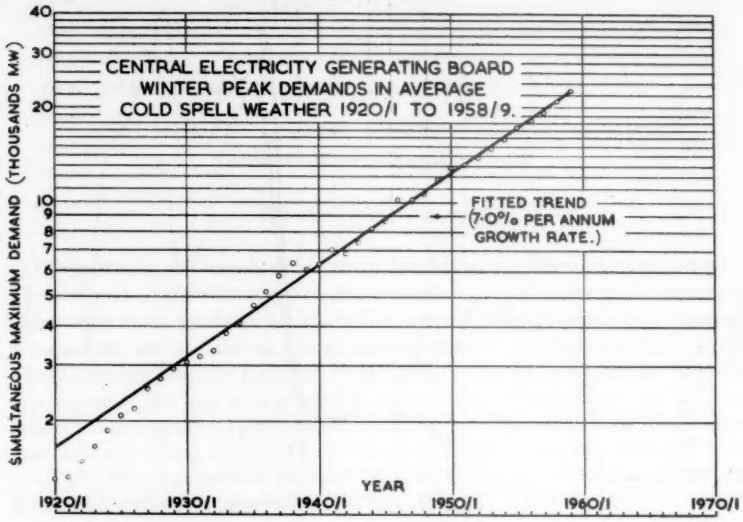

FIGURE 2

The design of the system for the production of electrical power is largely dictated by these three characteristics, the last of which is perhaps the most immediately interesting.

The main fuel in this country is at present coal, and this situation will continue for some time. The geographical location of coal is widely different from the geographical location of load, and this is illustrated in Figure 3. This figure shows in block diagram the relative sizes of the sources of coal to be used for generation in a specimen year—actually 1965–6, and the corresponding electrical energy requirements in various parts of the country. It will be seen, to take an example, that there is a deficit of local fuel in the London area and also in the north-west, whereas the Midlands has a large excess. This means that energy has to be moved from the coal-surplus areas to the deficit areas; this can be done either by transporting the coal to stations built in the deficit areas or by generating the electricity in the coal areas and transmitting the energy electrically.

Now leaving that thought for the moment, consider the grid system. A power station, as Professor Kay will have explained, is an aggregation of high-pressure boilers and high-speed turbines driving generators together with a multitude of auxiliaries. Such machines in common with most things made by man can never be completely reliable; apart from the necessary outage for routine maintenance, breakdowns are always possible. Since electricity cannot be stored, however, it is vital that sufficient plant should always be available to meet the load imposed by the consumer, and it is therefore necessary to provide spare plant to cover the

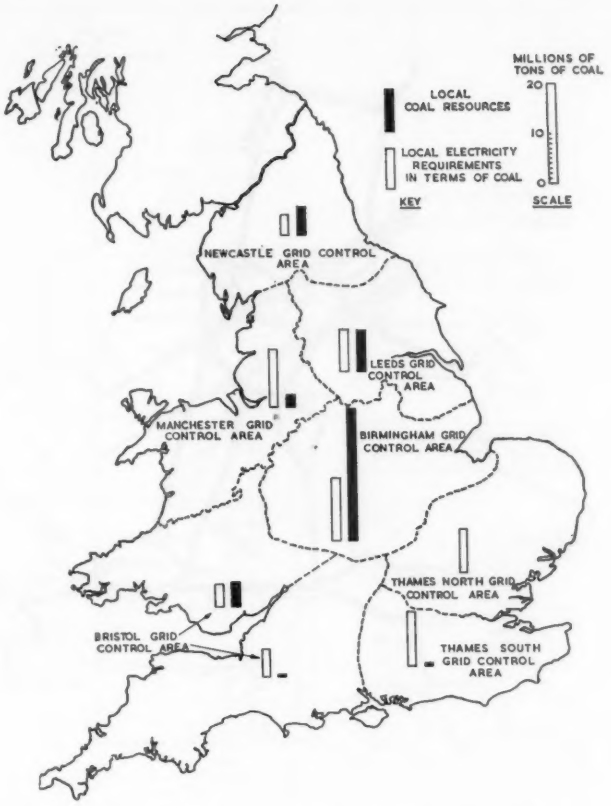

FIGURE 3. *Electricity requirements and coal resources 1965–6*

possibility of breakdown. Before the advent of the grid, enough spare plant had to be provided to cover the full risk in each independent power station. But if the power stations are interconnected electrically it will be readily appreciated that, since it is highly unlikely that breakdown will occur in all stations at the same moment, the aggregate amount of spare plant can be reduced. The original and still the main function of the grid system is this interconnection of stations to minimize the amount of spare plant which has to be carried. Built in the late 1920s and early 1930s to operate at 132,000 volts and since considerably expanded, the grid system has proved a very profitable investment from this point of view alone. As a secondary advantage it has yielded appreciable fuel savings by enabling production to be concentrated in the more economical stations. With the

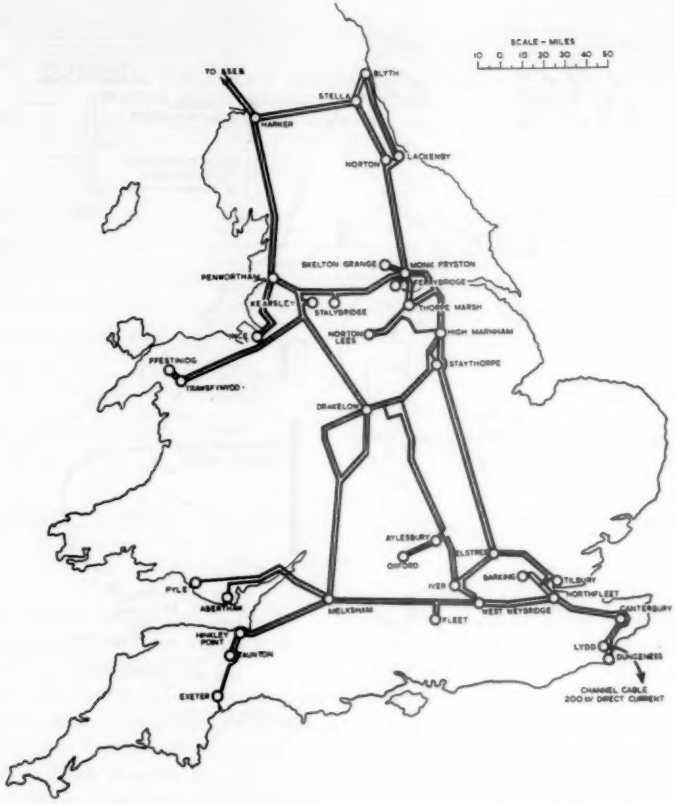

FIGURE 4. *Schematic diagram of the super-grid as it is planned up to 1963*

growth of demand, however, the 132,000 volt system became inadequate, and shortly after the war it was necessary to reinforce it with a superimposed grid running at 275,000 volts. Figure 4 shows a map of the country with this so-called super-grid system, the main function of which is to tie together the local systems and the larger individual stations in the different parts of the country, thereby reinforcing the 132,000 volt grid, which is no longer heavy enough for this duty but which retains the function of tying together the smaller individual power stations in each area and is also used to an increasing extent for the primary distribution of power to bulk-supply points on the lower-voltage distribution networks.

The super-grid system is economically justified for its interconnection function alone. In addition to this main duty, however, it was found possible, and indeed

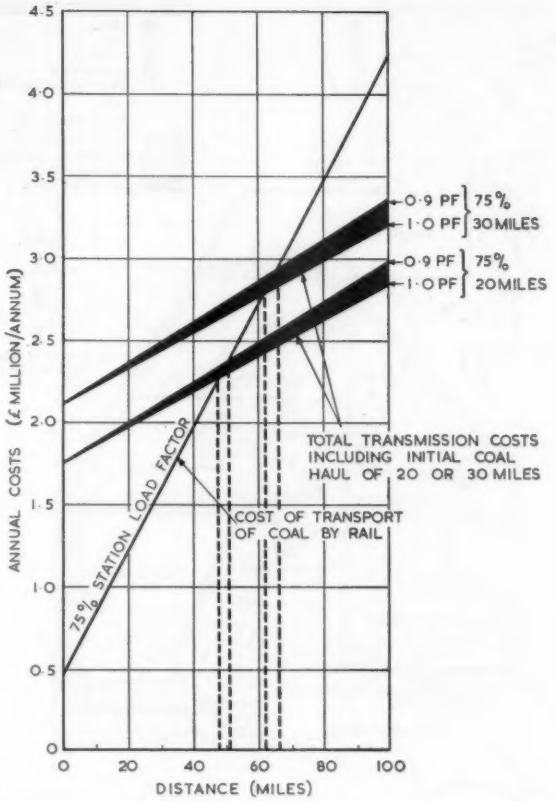

FIGURE 5. *Annual costs of transmission of electrical energy (including initial coal haul) compared with annual costs of transport of coal by rail. 275 KV transmission for 1400 MW generating station 1300 MW S.O.*

economic, to strengthen the system to enable it to perform the additional function of some bulk transmission of electrical energy. The justification for this is demonstrated in Figure 5, which shows the relative economics of transporting energy in the form of coal by rail from the coalfields to power stations situated adjacent to the load, and of transmitting energy electrically from stations on the coalfields. It indicates that, even allowing for the fact that power stations cannot be built at the pithead, and therefore an initial coal haul of 20–30 miles is necessary, it is cheaper to transmit power electrically over distances greater than 50–65 miles than it is to rail coal to stations built local to the load, providing the lines can be used at a high load factor, that is, be used for nearly twenty-four hours a day at

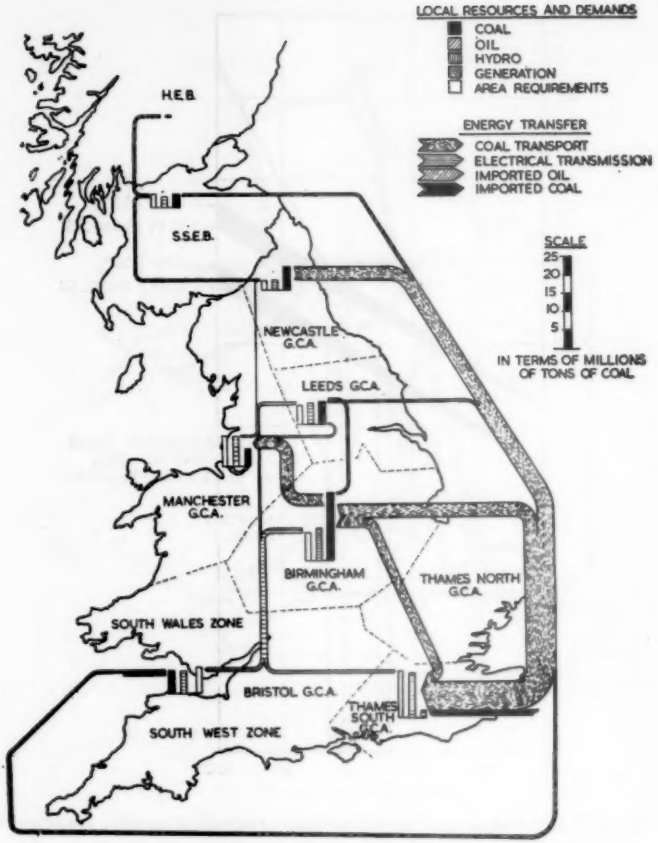

FIGURE 6. *Energy transfers in 1956*

loads approaching their normal full capacity. The use of sea transport for coal available close to a port to a station capable of receiving large ships would be cheaper still if such a station could be built close to the load, but this is now generally impracticable. In the London area, for instance, the large and growing demand to the west is some 50 miles or more from any suitable site on the Thames Estuary, and the resultant transmission costs discount the savings of sea transport. The picture shown in Figure 5 is thus generally representative.

The next two figures illustrate the applications of the above. Figure 6 shows the energy-transfer position as it was in 1956 before the super-grid system became operative, and it will be seen that, apart from the small amount of energy

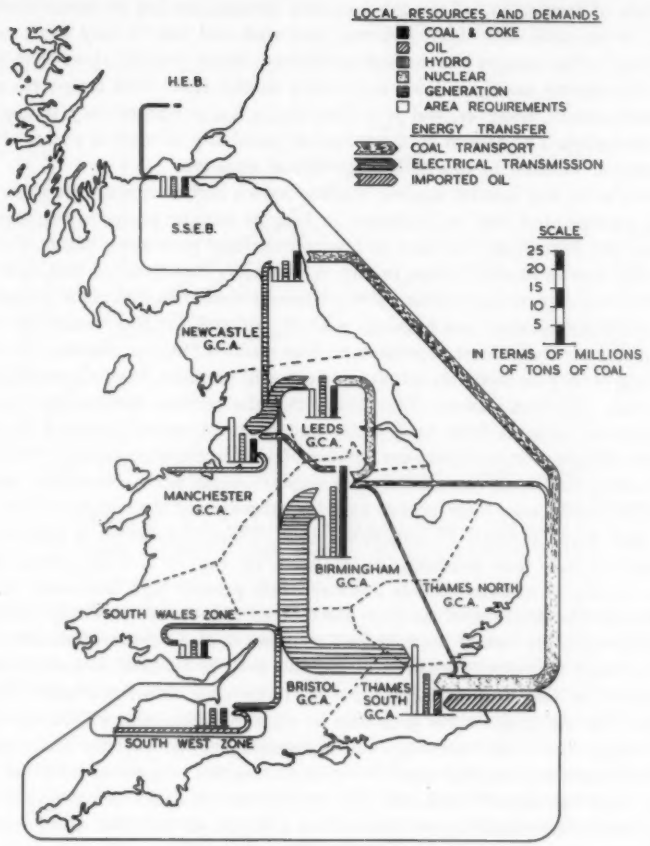

FIGURE 7. *Estimated energy transfers in 1964–5*

transmitted over the 132,000 volt grid, the basic picture is that coal is transported to the deficit areas by road, rail or sea. Figure 7 shows the picture as it will be in 1964/5, when the super-grid will be used for the major energy transfers, and only a comparatively small component will be by inland coal transport.

So much for the coal side of the background situation. It is entirely valid even though coal cannot fulfil all our future demands for fuel, and this brings us to the general question of fuel resources.

Figure 8 is a reproduction of a curve shown in the original White Paper, *A Programme of Nuclear Power* (Cmd. 9389, February 1955). It shows very forcibly the expected increase in demand for electricity and that there can be

no hope of meeting in full the consequential demand for fuel by home-produced coal. At the time that this curve was produced coal was in very short supply not only in this country but throughout Europe. Since then the short-term situation has greatly eased, and we will return to this later. The long-term trend remains correct, however, and it is clear that a fuel supplementary to coal will be imperative. The advent of the technical possibility of nuclear power offered a potential solution to this somewhat critical situation.

Now, as is well known, nuclear stations have a higher capital cost than coal-fired stations, and this is inevitable so long as nuclear power is employed as a source of heat to drive a more or less conventional generating plant, which is the only known method of use to-day. A moment's consideration will show this must be the case, since nuclear plant is basically similar to coal plant except that the relatively simple coal-burning gear is replaced by the immensely more complex and vastly more expensive nuclear reactor. Nuclear stations, however, burning as they do relatively minute quantities of uranium, have a lower running cost than coal-fired stations. This means that the nuclear stations must be run as nearly as possible fully loaded day and night in order to spread the high capital charges over the maximum number of units, thereby permitting them with their lower fuel costs more nearly to compete overall with a coal-fired station. In other words, they must be run base load throughout their expected life, and the peak load be taken by coal-fired plant. There is however a limit to the amount of base load available, as is shown by Figure 1. This means firstly that, so long as nuclear stations maintain their present high first cost, there is a limit to the amount of nuclear power that can be economically installed, determined by the size of the base load component of the power-demand curve; and secondly that every coal-fired station now built is designed *ab initio* for what is known as 'two-shift' running—that is, to be shut down overnight. It also means that one of the major problems in nuclear engineering will be to reduce the capital cost of the stations, even if necessary at the expense of increasing the running costs, if nuclear plant is to remain economic compared with coal-fired plant when the capacity installed exceeds the base load. To do more than state these basic facts would involve going into a degree of technical detail perhaps somewhat inappropriate to this lecture; suffice it to say that there do appear to be reasonable possibilities of developing nuclear power to meet the required economic criteria.

It was clear in 1955, however, that the new source of power could not be deployed either sufficiently fast or on a sufficiently large scale to meet the anticipated gap in fuel supplies. The use of imported fuel, either coal or oil, was necessary in the interim, and it will be recollected that at that time significant quantities of coal were in fact being imported. But, for a variety of reasons, it was decided by the Government that the short-term fuel gap in the generation industry should be met by the import of oil to the extent of 8 million tons per year of coal equivalent. The decision was accepted by the industry, and arrangements were made for some 14 stations to be changed over to oil. The stations chosen were all on the coast or estuaries giving direct access for tankers, and

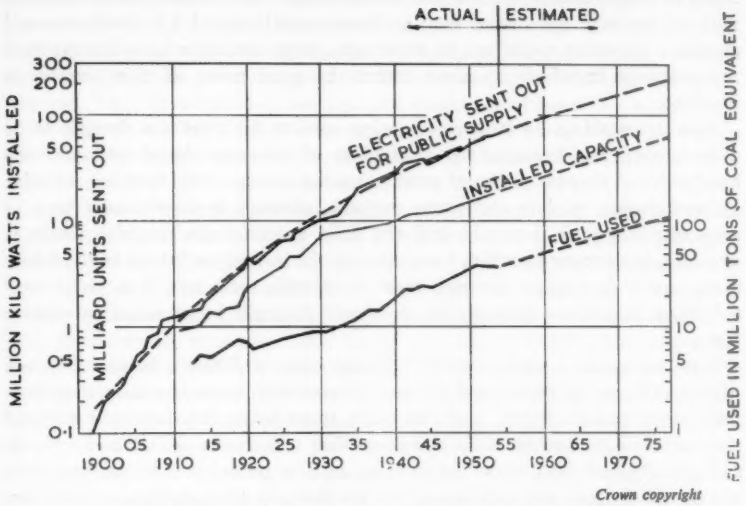

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FIGURE 8. *Long term trend in electricity sent out for public supply in Great Britain, capacity installed, and fuel used*

were all in coal-deficit areas—in the south or the north-west—to save coal transport costs; contracts totalling £13 million were placed for the necessary conversions, and very large and necessarily long-term contracts for the required oil were negotiated with the oil companies who themselves had to enter into large capital and other commitments in arranging the supply. Since that date the position in the coal-supply industry has of course changed; in Great Britain, as in Europe generally, far from the previous shortage there is at present a surplus of small untreated coals, and it appears that this position will continue at all events for the near future. To this extent therefore, the short-term forecasts have been proved mistaken and, as is well-known, some pressures have been building up for the reconversion of these stations to burn coal.

The present situation is therefore somewhat unfortunate. One of the basic industries of our country—coal—is in difficulty in disposing of part of its products whilst a sister nationalized industry is burning an imported substitute fuel, and it is hardly surprising that pressures have built up as a result. In fact, the situation has been eased to a considerable extent by friendly discussion between the three parties primarily concerned (the Generating Board, the Coal Board and the Oil Companies) assisted by Government Departments, and the oil-burning programme has been considerably reduced both in the short and the long term; for example, two new large stations originally planned to burn oil have been changed back to coal and these alone will burn over 3 million tons of coal per year by 1965. But there must be limits to the alterations which can be

made to commitments entered into on this scale. The oil industry is an international one and, apart from the significant capital expended by both user and supplier, extensive variations to these very large contracts have international repercussions in which to some extent the good name of this country is involved.

Broadly speaking, oil is therefore being used to fill what was thought to be a temporary gap between the availability of home-produced coal and the availability of the new source of power—nuclear energy. Oil, however, remains in good supply, as does coal at the moment, although it alone cannot hope to meet our long-term demands; and the third potential raw material, which is uranium, is also now plentiful. Consequently the industry will have in the future a reasonably free choice between these three basic fuels and, if no other consideration intervenes, the scale of use of each fuel will be governed by relative costs.

Now, as we have seen, as well as having quite a different balance between capital and running costs, nuclear power is somewhat more expensive than coal-fired power and therefore, at the moment, there seems little incentive to build more nuclear stations than the minimum that will insure against a short-term fuel gap. Against this, in the longer term, nuclear power is essential, and both the knowledge and the techniques, and the industry to apply these techniques, must be available to meet the ultimate requirements. A power station takes some four years to design and build and thereafter has an operating life of twenty years or more, so that in settling the relative economics of the alternative fuels it is necessary to forecast the position at least ten to twenty years ahead. This is extremely difficult, involving, as it does, not only the assumption that what is now technically impossible will be both technically possible and economically attractive within reasonable time, but also forecasts of the probable price and availability of coal. The situation is complex and could provide material for a whole series of lectures. It must suffice to say here that nuclear power is a long-term necessity, that at the moment it is marginally uneconomic, that nevertheless its continuing development necessitates the continuing construction of stations, that the development thereby permitted is already reducing the costs to a point where they are in sight of becoming competitive with coal, and that there is a reasonable prospect that by about 1970 such a station will produce cheaper units than a coal-fired station. All these comments are conditioned by the earlier postulate that, until their capital cost can be substantially reduced relative to coal-fired stations, nuclear stations must enjoy a high load factor throughout their expected life. It follows that a considerable proportion of new stations will have to operate at much lower average life-time load factors, and there seems little doubt that these must continue to be coal-fired. This in turn means that the coal consumption of power stations will, in spite of increasing use of nuclear plant, continue to increase and not decrease.

Technically, the advent of nuclear power permits new freedoms but also imposes new restrictions on the siting of the power stations. Clearly, nuclear

stations should preferably be sited in coal-deficit areas, which, as Figure 3 shows, means broadly the south of the country or the north-west. They raise none of the problems involved in the transport of the large tonnages of coal—perhaps up to 3 million tons per annum—to an orthodox station, nor the problem of ash disposal. They have however, two essential conditions of existence, which make them difficult to site. First, the nuclear reactor in its present form is strictly limited in the top gas temperature it can produce, which at the moment is about 400°C., and this limits the steam temperature to about 380°C., as compared to 550°C., or a little more, for an ordinary coal-fired station. Consequently the thermodynamic efficiency of the nuclear station is low, so that the amount of heat rejected is large, so large in fact that it can usually be disposed of economically only to the sea. This means that the stations must be situated on the coast or on large estuaries. (An exception is the Trawsfynydd station where a large inland lake provides the means for dissipation of heat.) Secondly, the authorities insist, in my view correctly, that the stations should not be situated close to densely populated areas. This requirement is one which is commonly misunderstood, it being complained that the Generating Board say in one breath that the stations are safe, and in the next that they are so unsafe that they must be segregated. The criticism is, I suggest, unfair. The stations are safe, as safe as man knows how to make them, and certainly as safe as many common industrial processes. But mankind is not infallible, and we are applying new knowledge. In logical recognition of these two facts each station is therefore sited in such a position that, should the utterly unexpected occur, then continuing safety can be preserved either by simple instruction to, or, in the ultimate extreme, temporary evacuation of, individuals in the vicinity of the station. Sited as the stations are, the solution to the administrative problem of catering for the ultimate unknown is feasible, which it would not be near a densely-inhabited area. The argument is as simple and, in my view, as logically unassailable as that, but it does raise the whole question of siting with its associated problems of amenity which will be referred to later.

Let us now briefly recapitulate the situation we have reached. Coal is, and for some time will remain, our basic fuel. The geographical location of coal resources is different from the geographical location of load. The interconnection of power stations is economically necessary, and the superimposition of bulk transmission of electrical power from the coalfields to the load is economic. At present nuclear power is marginally uneconomic, but its future development will probably change this, and further permit its economic use at lower, but not the lowest, load factors. Nuclear power is best developed in the coal-deficit areas, and must at present be sited on the coast.

The present and future pattern of the industry now emerges. In recent years new plant approaching 1,800 MW per annum has had to be installed to cover the increase in load and the obsolescence of plant, and from now onwards this will increase to well over 2,000 MW Developments in techniques have permitted the average size of individual stations to increase from around 200 MW. in pre-war days to over 1,000 MW in the coal-fired case, and to about 500 MW in

the nuclear case, and thus about three new stations are, and will continue to be, required each year. For the past ten years, siting on the coalfields has been planned for the majority of new coal-fired power stations, and this policy will continue to be followed in the future. The still comparatively small component provided by nuclear power is in coastal or estuarial stations in the coal-deficit areas, and this will also continue. As the nuclear component grows, the bulk transmission from the coalfield stations will diminish and their load factor will fall, but the line capacity thereby made available will be absorbed by the increased interconnection capacity required by the larger system, and perhaps eventually to some degree in transmitting power from the nuclear stations to more distant load areas in order to maintain the high load factor necessary for these stations to be economic. Gradually the dominating influence of interconnecting requirements on the pattern of the supergrid will be modified by the growing influence of transmission requirements. Generator sizes and station capacities are becoming too large to be accommodated on the 132,000 volt system, and every large new power station to be commissioned after 1962 will be directly connected to the 275,000 volt system, which will have to transmit the whole of its output to transforming stations feeding the 132,000 volt and lower-voltage systems.

Let us now glance in slightly more detail at the way in which this general picture is being implemented. The salient feature in coal-fired generation is the great advance in size and steam conditions, and consequently thermal efficiency, which the continuing expansion of the system and its complete interconnection

Unit Size	*Inlet Steam Pressure and Temperature*		*Year First Commissioned*	*Thermal Efficiency*		*Cost Per kW. s.o.*
MWI	PSI	°F		*Optimum* %	*New Plant Base Load* %	£
30	600	850	1948		26	67
60	900	900	1950	30·8	29	57
100	1500	1050	1956	33·9	32	58
100 R*	1500	975/950	1957	34·7	33	59
120 R	1500	1000/1000	1958	35·9	34	53
200 R	2350	1050/1000	1959	37·7	36	50

*R = Reheat

FIGURE 9. *Sizes of generating units installed in recent years*

has permitted. This is shown on Figure 9, which tabulates the generating units which have been installed in recent years. The 30 MW and 60 MW units, of which large numbers were installed or ordered in the early post-war years head the table and give datum points; the 60 MW unit with steam conditions 900 lb./sq. in. 900°F. gives an optimum thermal efficiency of 30·8 per cent and at present-day prices costs about £57/kW s.o. The first step forward is the 100MW 1500/1050 unit at 33·9 per cent and £58/kW.s.o. followed by the 100 MW reheat unit 1500/975/950 at 34·7 per cent and £59/kW.s.o. This reheat unit is rapidly replaced by the 120 MW at higher steam conditions and the 200 MW at 2350/1050/1000, which gives a further advance in thermal efficiency to 37.7 per cent and a further drop in capital cost to £50/kW.s.o. The impressive fact is that there has been a progressive and simultaneous increase in thermal efficiency (which, of course, means a corresponding reduction in the consumption, and therefore the cost, of fuel) and reductions in capital costs, and this in large part explains the fact that although the price of goods in general, including coal our basic fuel, has increased on average by nearly 200 per cent since 1939, the average cost of electricity to the public has increased by only 46 per cent. The technical story of these advances is a fascinating one. They are the result of a considerable effort by all concerned, and have involved, as any development must, the taking of appreciable technical risks; but this lecture is perhaps hardly the appropriate place to describe them in detail.

On the nuclear side the development has been equally, if not more, spectacular. The first nuclear power station in the world generating electricity on any appreciable scale was commissioned at Calder Hall in 1956 and each reactor produced some 37 MW of electrical power. The first commercial stations, at Bradwell and Berkeley, due to be commissioned in 1961, will each send out 150 MW from each reactor, and Hinkley Point, designed only some 12 months later, will produce some 250 MW per reactor. Again, however, this is hardly the place to discuss the specific technicalities involved in this very rapid advance in this young science.

Such rates of growth in both spheres have, however, been stimulated by the growth in demand for electricity, and it is this growth in demand and the Supply Industry's duty to meet it which forces their activities more and more before the public eye. The industry is already a large one, and the doubling in demand every 10 years or so, necessitating as it does a capital expenditure of some £200 million per annum, suggests that the resulting power stations and transmission lines must become more numerous and therefore more noticeable. The only way entirely to prevent this would be to prohibit further growth in the demand for electricity, and this is impossible if we are to maintain, let alone improve, the standard of living of this country, or, indeed, to retain a place as an efficient industrial producer in world markets.

Every possible step is, however, being taken to reduce the impact of this expansion upon amenities. For instance, largely as a result of forcing technical development as fast as possible, the power stations are many times larger than those built only 10 years ago and therefore fewer sites are required; the increase

in voltage to the 275,000 of the super-grid from the 132,000 of the original grid multiplies by five the power transmitted per line and thereby reduces the number of lines required although at the expense of higher and therefore more obtrusive towers. These and similar technical advances materially reduce the impact of the expansion upon the country in general, but cannot completely mask it. The problem is a difficult one, too difficult to discuss in the brief space available in a general paper of this sort, but it was the subject of a lecture to this Society by Sir Christopher Hinton and Sir William Holford last year*, and I cannot do better than refer those interested to this lecture, copies of which are, I understand, available.

* See *Journal*, February, 1960, p. 180

III. THE RETAIL DISTRIBUTION OF ELECTRICITY

by

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Chairman, Electricity Council

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INTRODUCTION

This is the third of the Cantor Lectures on Energy and I must make some reference to the first two lectures in order that the sequence may be quite clear to my listeners.

Professor J. M. Kay gave the first lecture and described the technology of the generation of power from various primary energy sources. In the second lecture, my colleague Mr. Stanley Brown, Deputy Chairman of the Generating Board, dealt with the way in which the Board's system of generation and main transmission had been evolved over the years, and his lecture concluded at the point where the current was delivered at various supply points to the Area Boards, for distribution and sale to the consumers. That is where I pick up the story, in order to explain to you some of the complex problems associated with the retail distribution of electrical energy to the consumers, including tariffs and the service which is generally provided to meet the needs of electricity consumers to-day.

At the present time there are more than fifteen and a half million consumers of electricity in England and Wales whose requirements are catered for by the twelve Area Electricity Boards, the boundaries of whose areas are shown on the map of Figure 1. Prior to nationalization of the Supply Industry under the Electricity Act 1947, which became effective on 1st April, 1948, there were about 580 municipal and company undertakings in Great Britain, and at that time they had to deal with about eleven and a half million consumers. The 1947 Act provided for fourteen Area Boards, including those for South-West Scotland and South-East Scotland. These two Boards were later merged in the South of Scotland Electricity Board which was established by the Electricity Reorganization (Scotland) Act of 1954.

The Chairman, Deputy Chairman and other members (four to six, mostly part-time) of the twelve Area Boards are appointed by the Minister of Power, and each Board has almost autonomous powers under the Electricity Act of 1957. Prior to that, the 1947 Electricity Act provided that the Area Boards should be subject to some measure of co-ordination by the Central Electricity Authority, but the 1957 Act removed these powers of co-ordination to some extent, and only in the fields of labour relations, research and development, and finance for capital development, are the Area Boards required to conform to a common policy decided by the Electricity Council. Each of the twelve Area Board Chairmen is a member of the Electricity Council.

FIGURE 1. *Area Electricity Boards*

One might reasonably ask, why twelve Area Boards for England and Wales? It is believed that when the number of Boards was decided upon, an attempt was made to fix the boundaries of each Board so that it constituted an economic working unit and that within its boundaries (excepting London) each Board contained a fair and reasonable proportion of undeveloped rural territory. The ultimate result of this policy produced Area Boards which, in general, had between 4,000 and 7,000 square miles of territory each, but which varied very considerably as to consumers, revenue, units sold, etc.

For ten years from Vesting Date in 1948 I was Chairman of the East Midlands Board, which has an area of some 6,200 square miles with a large proportion of

rural territory. Based upon that experience I would say that more efficient and manageable units might have been established by reducing the size of individual Boards and increasing the number from twelve to, say, fifteen or sixteen. This, owever, is a matter upon which differing views are held by people holding esponsible positions in the Industry.

For each Area there is a Consultative Council appointed by the Minister and consisting of a Chairman and not less than twenty or more than thirty members. The Chairman of this Consultative Council is a part-time member of the Area Board and he is the vital link between the Consultative Council and the Board. These Councils are authorized to consider any matters affecting distribution within their area, including variations of retail tariffs and the provision of new and improved services and facilities, and they may make representations on these matters to the Area Boards. If the Area Board fails to satisfy the Consultative Council on their representation, the Consultative Council may refer it to the Electricity Council and, failing satisfaction from this body, may make a further appeal direct to the Minister of Power. Although they are more active in the field of retail tariffs, it is important to note that, under the 1957 Act, Consultative Councils may consider the effect of the Generating Board's Bulk Supply Tariff and its application within the area they serve.

As previously stated, each Area Board Chairman is a member of the Electricity Council, which body was established by the 1957 Act to shape the policies and control the destinies of the whole of the Supply Industry of England and Wales.

The Central Electricity Generating Board, which was created by the same Act of 1957, are entitled to nominate three members of their Board as members of the Electricity Council, and one of these must be the Chairman of the Generating Board. In addition to these members, the Electricity Council has a full-time Chairman, two Deputy Chairmen (who may be full-time or part-time) together with one other full-time member and not more than two part-time members.

Thus we have a total of twenty persons in the Electricity Council, and this number might be increased to twenty-one if the Minister should decide to appoint an additional part-time member to fill the vacancy which exists. This, then, is the body which must control the whole future of the Supply Industry and advise the Minister of Power on all matters relevant thereto. It is a body which must reach agreement upon all important matters, because if it fails to do so these matters would have to be submitted to the Minister who would be the final arbiter.

SUPPLIES TO THE AREA BOARDS

To convey a clear idea of how electricity is received by Area Boards from the Generating Board at bulk supply points and distributed by the Area Boards to their consumers, it seemed desirable to include an outline plan of the system of one area Board. Because I know the area better than any other, I have selected the East Midlands Electricity Board—see Figure 2.

It will be seen that the bulk supply points comprise some which take the form of substations on the National Grid lines, whilst others are actually on the sites

FIGURE 2. *East Midlands Electricity Board bulk supply points*

of the generating stations. In addition, the Figure shows that small supplies are also being fed into the Board's system from three industrial generating plants. This is a pattern common to all areas.

The electricity required by each Area Board for the whole of its consumers is taken and metered at these points. As a general rule, the metering points constitute the dividing line between the plant and equipment owned and operated by the Area Board and the Generating Board respectively. The Generating Board usually provide the transformers necessary to supply current at a voltage which will suit the distribution system of the Area Board in that particular locality. Generally speaking, these high-voltage supplies are taken by Area Boards at 66 kV, 33 kV and at 11 kV.

Although some of the substations at these bulk supply points are continuously manned, the method of remote control from one or other of the major substations is in general operation. This remote control system is so designed that it reports load conditions, faults and abnormalities, and provides facilities for opening and closing switches and for the adjustment of voltages by the use of tappings on the main transformers.

Bulk supply points are seldom afforded direct from generating stations of recent design, mainly because these new generating stations are not located with a view to supplying nearby industrial load but rather to feed electricity into the National Grid from points on or near to the coalfields and also where there are abundant water supplies for cooling purposes.

Under the 1947 Electricity Act, Area Boards were not allowed to generate electricity but were permitted to purchase additional supplies from other sources, subject to the consent of the Central Authority. In the later Act of 1957, powers were given to Area Boards permitting them to generate electricity within their area, provided that this was only done after consultation with the Generating Board and the Electricity Council, and that it was subject to the final approval of the Minister of Power. Instances where such a course would be warranted are somewhat rare but could arise, for example, in cases where small power stations might be more economic for dealing with particular supplies in a remote area than as reinforcements to distribution lines.

The powers given under this section of the Act were exercised for the first time in the autumn of last year, when the South Western Electricity Board commissioned a small, remote-controlled generating plant situated on Dartmoor but under supervisory control from Bristol. The plant is capable of dealing with 3,000 kW of load and acts as standby to the existing distribution lines, which otherwise would have had to be reinforced at considerable expense.

DISTRIBUTION SYSTEMS

Alternating current at a frequency of 50 cycles per second has for many years been recognized as the standard for electricity supply in Great Britain. Before the nationalization of the industry in 1948, each of the large number of separate undertakings that then existed had their own individual distribution systems, and although voluntary attempts had been made to standardize these systems and the supply voltages, many consumers were supplied by means of direct current and there was a great variety of voltages from 100 V up to 250 V single-phase and 440 V three-phase.

One of the first tasks of each Area Board was to try and establish a standard system of distribution voltages, the decision having been made just prior to nationalization that the standard for low-voltage supplies should be alternating current three-phase 415 V and single-phase 240 V. During the last twelve years much time and effort has been given to this problem, and wherever it was possible to change a system over to the standard voltage of 240 V single-phase without incurring substantial capital cost, this work has been carried out. But restrictions on capital have retarded progress and there are some consumers

still supplied by direct current and many more who receive alternating current supplies at non-standard voltages.

The extra-high-voltage system of an Area Board (usually 33 kV) forms the backbone of the Board's distribution system, and these main feeders convey electricity from the bulk supply points to a number of major distribution substations where the energy is transformed down to 11 kV or 6·6 kV.

66 kV and 33 kV lines may be overhead or underground according to circumstances and the density of building along the route of the line. It is important to remember, however, that the cost of 66 kV underground cable as compared with overhead lines is something like six times as great, and of 33 kV underground cable, about four times as great. Some of the heavier overhead lines are carried on steel poles or lattice steel towers, but wood poles are used for the lighter lines.

Generally speaking, at major distribution substations the higher voltage switchgear and transformers are placed outdoors for reasons of economy, but occasionally site conditions make it imperative for the gear to be housed. Remote control of these distribution substations is not usually worth while unless they are of exceptional size, but widespread use is made of automatic systems for varying the tappings on transformers to maintain correct voltages, and in some cases also for restoring supplies quickly in the event of a fault on the lines or cables.

Where large supplies are required, these may be delivered direct to the consumer at 66 kV or 33 kV, but the great majority of industrial consumers take their supplies from Area Boards at voltages of 11 kV or less. The voltage having been transformed down to 11 kV or 6·6 kV at the major distribution substations, the supply is now in a form in which it can be sold to a considerable number of large consumers. Thousands of factories, office blocks and institutions take their supply at these voltages, and substations are provided on the individual premises to transform the current down to the standard voltage of 415/240 V, and thus make it suitable for immediate use.

For the great mass of small consumers the Area Boards have to provide substations to transform the energy to 415/240 V, and there are many and various types of substations used by Boards for this purpose depending upon the type of locality, for example city centres, smaller towns and suburbs, and rural areas.

The construction of a distribution system within a city centre is largely governed by the availability of sites for substations and by the high cost of breaking up the streets to lay additional cables. These problems are less acute in the smaller towns and suburbs, but because the growth of load is so rapid and unpredictable, the design of the distribution system must be flexible to allow for the provision of additional substations to meet the growth of load. The development of the direct-buried transformer opens up opportunities in districts where difficulty is experienced in obtaining adequate substation sites in congested areas. Installation can be effected at kerb edge, fence line or in any available location.

Because of the greater distances which have to be covered and the relatively

small amount of revenue which can be obtained from the sale of electricity, the use of overhead lines in rural areas becomes imperative. Underground cables with their greatly increased cost would make it impossible for electricity to be offered to rural consumers at acceptable rates. Area Boards usually establish a secondary backbone of 11 kV or 6·6 kV ring mains or major spur lines running from the major distribution substations to rural load centres. From this secondary backbone, light 11 kV or 6·6 kV spur lines are tapped off through fuses and run to villages and farms where pole-mounted transformers are provided. Very often, in order to reduce expense to a minimum, these light lines are of single-phase two-wire construction, instead of three-phase three-wire. Some rural consumers, usually farms, provided with this single-phase supply are faced with a slightly increased expense in providing single-phase motors instead of motors of the three-phase design in more general use.

COSTS AND TARIFFS

An Area Board must ensure that the whole of the costs incurred in purchasing and distributing energy is recovered in a proper and fair proportion from the individual consumers, whether they be industrial, commercial or domestic in character.

The purchase of electricity from the Generating Board represents something like 70 per cent of the total costs incurred by each Area Board. The Generating Board is responsible, after consultation with the Electricity Council, for designing the Bulk Supply Tariff which will enable it to collect from Area Boards the whole of the costs incurred on generation and transmission. These will include depreciation and a modest surplus which, taken together, should enable the Board to finance a reasonable proportion of its future capital expenditure.

The Bulk Supply Tariff has always been a two-part tariff, including a fixed charge per annum per kilowatt of maximum demand and a running charge per kilowatt-hour (unit) supplied. The latter is kept as low as possible and covers the actual running costs at the generating stations, the major proportion of which is the cost of fuel.

At present, the kilowatt charge made by the Generating Board is at the rate of £7 2*s*. per kilowatt of maximum demand per annum, and the running charge, 0·41 pence per unit based on a fuel cost of 60*s*. per ton and applicable to all units supplied.

The running charge is subject to an adjustment which depends partly upon the average cost of fuel used at the power stations in the area of each Board and partly upon the assessed cost of importing energy into the area of any particular Board. Thus the costs of purchasing electricity incurred by any individual Board reflect local differences in the costs of fuel (principally coal), and it follows that Area Boards which embrace coal-producing areas in which modern generating stations have been erected, obtain their supplies in bulk at an average cost per unit which is somewhat lower than that which obtains in those areas, chiefly Southern England, which are remote from the coalfields.

Area Boards' retail tariffs must necessarily be designed in such a way as to collect something like £500 million per annum in fair proportions from about fifteen and half million consumers. In this connection it may be noted that something like 13 million of these consumers pay on an average less than 5*s*. per week, which means that many of these consumers spend a good deal less than 5*s*. per week on their electricity supplies.

Immediately after Vesting Date the Central Authority, with the approval of the Area Board Chairmen, established a Retail Tariffs Committee, whose main task was to produce a report on tariff structures which would be substantially uniform for the whole country, even though the price content of the tariffs might vary from area to area. It was under the guidance of the Report of this Committee that Area Boards designed their retail tariffs to deal with four main classes of consumers, viz., industrial, commercial, domestic and farms. Each Area Board, after close investigation into its costs, produced retail tariffs under each of these four headings, and these tariffs were designed to recover the approximate costs of the supply afforded to each of these four main groups. It was, of course, essential that these tariffs should be as simple as possible and easily understood by consumers.

The designing of retail tariffs is a most complicated subject and one which requires a tremendous amount of research into factual costs, and this research must be continuous in character. Retail tariffs must be designed to encourage consumers to make more and more use of electricity, especially during off-peak periods, and this was the principal reason for fixing a low unit charge as one of the components of the Generating Board's Bulk Supply Tariff. Although the retail tariff leaflets issued by individual Area Boards show variations in the price content, there is a broad pattern of agreement as to structure, as examination of the retail tariffs for the four main classes of consumers will show.

Almost invariably, large industrial supplies are provided to the consumer on the basis of a maximum-demand tariff which bears some relationship to the two-part tariff for bulk supplies to the Area Board. The fuel adjustment clause usually operates from a basis of 60*s*. per ton, which is the same basis as that contained in the Bulk Supply Tariff. The actual cost of fuel for the purpose of calculating the fuel adjustment is supplied to each Area Board every month by the Generating Board. Other industrial supplies, smaller in character, may be charged on a maximum-demand tariff, but for these there is an alternative tariff with block unit rates; it contains no measured maximum-demand charge and no fuel adjustment clause.

Large commercial premises may qualify for a maximum-demand tariff very similar to that offered for industrial consumers, but an alternative block tariff is offered for most commercial premises, consisting of a relatively high rate per unit based upon floor space area or on the electrical loading of the various appliances installed, together with a low rate per unit for excess units.

It is quite impracticable and too costly to offer a maximum-demand tariff for purely domestic supplies. All Boards offer either block-rate tariffs, consisting

of a unit charge for an initial block of units based upon the number of rooms, together with lower unit charges for all additional units; or two-part tariffs, with a quarterly fixed charge based on floor area, together with a unit charge. For the smaller domestic consumer, supplies may be delivered through a pre-payment slot meter, involving some small additional charge.

The tariff for a farmhouse with outbuildings is generally a combination of the domestic tariff, for the dwelling house, and a form of commercial tariff usually related to the installed load of the electrical farming equipment.

Specially low prices are available to all classes of consumer for supplies which are given during off-peak periods only.

TABLE I

AVERAGE REVENUE PER UNIT OF ELECTRICITY SOLD, BY CONSUMER CATEGORY, 1958-59

Area Board	*Domestic*	*Farms*	*Commercial*	*Combined Domestic and Commercial*	*Industrial*	*Public Lighting*	*Traction*	*Total (Excluding inter-Board Sales)*
			Pence per unit sold					
London	1·843	2·207	2·387	—	1·898	1·487	1·932	2·018
South Eastern	1·676	1·714	2·110	1·886	1·426	1·897	1·514	1·670
Southern	1·653	1·535	2·071	1·870	1·539	1·843	1·488	1·670
South Western	1·913	1·782	2·148	—	1·433	1·739	—	1·795
Eastern	1·810	1·766	2·047	2·062	1·504	2·260	2·098	1·740
East Midlands	1·735	1·546	1·987	1·816	1·322	1·519	1·205	1·532
Midlands	1·559	1·506	1·825	1·856	1·330	1·250	1·256	1·457
South Wales	1·726	1·637	1·827	—	1·134	1·488	1·283	1·298
Merseyside & North Wales	1·647	1·627	1·767	1·659	1·203	1·381	1·238	1·415
Yorkshire	1·619	1·494	1·947	1·896	1·159	1·413	1·188	1·364
North Eastern	1·751	1·722	2·192	—	1·300	1·725	1·296	1·529
North Western	1·496	1·384	2·137	1·879	1·374	1·473	1·166	1·505
Total—All Area Boards	1·698	1·595	2·095	1·882	1·342	1·605	1·418	1·577

From Table I it will be noted that, although there is some variation in the selling price of electricity as between Board and Board, the overall effect is to produce for each class of user an average price per unit which in general is lower in those areas which are mainly industrial in character.

CONSUMER SERVICE

The main task of any Area Board, apart from providing and maintaining a supply of electricity to all its consumers, is to supply a public service of a comprehensive character. All Area Boards have established numerous service centres or showrooms and from time to time take part in exhibitions and displays in order to offer the best possible advice and assistance to consumers who wish to purchase domestic appliances and who require day-to-day advice on questions relating to their installations and to the tariffs for the supplies they receive. These services to consumers are supplemented by the British Electrical Development Association, which is a separately constituted body governed by a Council consisting principally of Area Board Chairmen. The whole of the finances of B.E.D.A. are provided by the Supply Industry.

In addition to selling various electrical appliances from their service centres, Area Boards also undertake contracting and the repair and maintenance of apparatus and endeavour to give the consumer that day-to-day service which is such an essential feature of electricity supply.

FIGURES FOR A 'TYPICAL' AREA BOARD

It has already been stated that the pattern of Area Boards is a varied one, but in order to illustrate the scale of operations of the Boards generally, it is necessary for you to see the figures of a 'typical' Board and for this purpose the East Midlands Electricity Board has been chosen. Apart from my personal knowledge of this particular Board, it is one where the total demand for electricity is divided almost equally between industry on the one hand and domestic, commercial and other consumers on the other hand. It also has a substantial proportion of rural area, and altogether serves an area of about 6,200 square miles, which makes it the third largest of the twelve areas in England and Wales.

The East Midlands area has a population of nearly four millions, the overall population density being 615 per square mile. About 32 per cent of this population is to be found in sparsely populated areas of the rugged hill country of the Peak District of Derbyshire and the agricultural plains of Lincolnshire, Nottinghamshire and Northamptonshire. By contrast, the cities of Nottingham, Leicester and Coventry and the important boroughs are all densely populated areas.

The area covers extensive coal and iron-ore fields and it is natural that heavy industries have been established within its boundaries. But it is true to say that practically every known industry is represented, including large-scale engineering, railway workshops, aircraft engines and parts, cement works, chemical works, electrical machinery factories, bicycles, etc. Of the lighter industries, perhaps the most noteworthy are boots and shoes, hosiery, lace and textiles, and potteries and china works.

In the rural areas, there are some 27,400 potential farm consumers, and the 25,000th farm to be supplied with electricity was connected to the Board's system in October, 1959. The total percentage of farms connected to date is

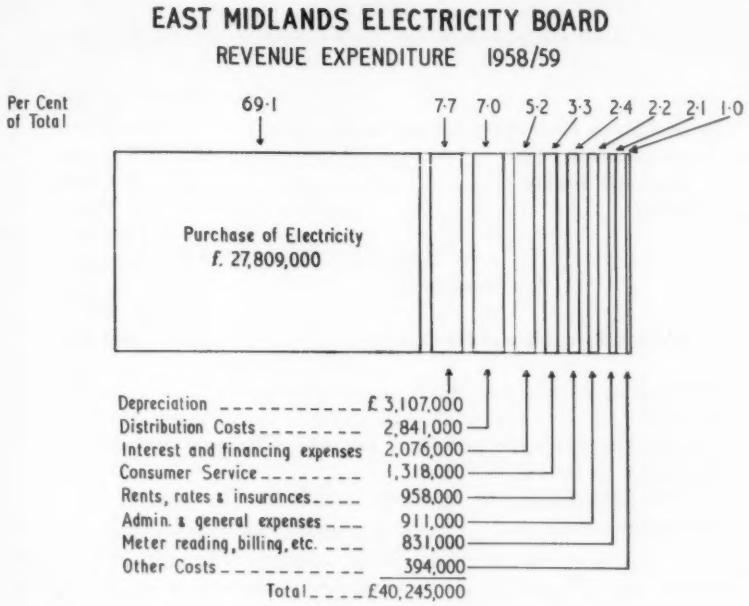

FIGURE 3.

approximately 92 per cent, and nearly 14,000 of these farms have been connected during the last twelve years.

All these widely-spread and widely-differing industries, together with the development of rural supplies, bring a constantly increasing pressure to bear upon the Area Board for the supply of electrical energy required to meet their continuous growth. The task of keeping the industrial and rural programmes of expansion advancing equally and simultaneously calls for sound planning and a keen and efficient administration.

The East Midlands Board's distribution system receives bulk supplies from the Generating Board's system at thirty-three separate points and comprises approximately 25,000 miles of mains and over 15,000 transforming points and substations. The Board is divided into nine Sub-Areas and twenty-seven Districts for convenience of administration and has a total of some 10,300 employees.

Table II gives the main financial statistics for the year 1958-59 and is supported by the diagram of Figure 3, which gives the analysis of revenue expenditure. It will be seen from the Table that the total expenditure on fixed assets amounted to £95·1 million, mainly related to mains and services, plant and machinery. Included in 'Other Assets' are land and buildings for substations, meters and apparatus, etc.

TABLE II

EAST MIDLANDS ELECTRICITY BOARD MAIN FINANCIAL STATISTICS, 1958–59

	£ *million*
Expenditure on Fixed Assets: at 31st March, 1959	
Mains and Services	58·2
Plant and Machinery	21·9
Other	15·0
Total	95·1
less Depreciation	43·5
Written-down value of Fixed Assets	51·6
Net Tangible Assets at 31st March, 1959	59·6
Revenue	42·1
(including surplus on contracting and sales of fittings)	
Expenditure on Revenue Account	40·2
(The diagram of Figure 3 gives the breakdown of this item)	
Net Surplus	1·9

For the year in question, the purchase of electricity in bulk at a cost of £27·8 million accounted for 69·1 per cent of the total expenditure on revenue account. The wages and salaries bill, which included employer's payments for superannuation, national insurance and the like, accounted for approximately 11·1 per cent. After meeting interest and depreciation charges, there was a net surplus of £1·9 million.

Table III gives statistics of electricity supplies by the Board in 1958-59. It will be noted that the industrial sales of electricity accounted for 54 per cent of the total sales.

This is a brief, very brief, word picture of the activities of one of the twelve Area Boards. Each of the Boards has its own individual problems but the main pattern throughout the country is the same, varied perhaps because of the spread of the population and the industries served and possibly affected to some extent by the geographical features of an individual area.

THE FUTURE

Electricity supply is one of the youngest of our great industries. Although some electricity was supplied, principally for lighting purposes, seventy years ago, the greater part of the growth of the industry has taken place during the last forty years. To-day, that growth is being maintained at such a pace that the total system load and the units supplied double themselves roughly every ten years, and there are no indications that the rate of growth will suffer any reduction in the foreseeable future.

TABLE III

EAST MIDLANDS ELECTRICITY BOARD ELECTRICITY SUPPLIES, 1958–59

Number of Consumers: at end of year		1,304,000
Electricity Sales:		
	million units	*per cent*
Domestic	1,940	30
Farm	196	3
Commercial	653	10
Combined Domestic and Commercial	128	2
Industrial	3,440	54
Public Lighting	53	1
Traction	21	0·3
Total	6,431	100
Maximum Demand		1,796,000 kW
Load Factor		44·5%

In the works and factories, new and better uses are being found for electricity almost every day; and automation, which is based on the use of electricity, is becoming an accepted practice. In industrial heating, there are many usages to be more fully explored, not least in the iron and steel industry. The programme of electrification of the railways is well under way and the coming years should see tremendous advances in this field.

The general standard of lighting in our streets, offices, factories and homes has improved considerably during the last twenty years, but no one will deny that there is still room for considerable improvement. Electrical appliances of many kinds are now regarded as a necessity in every household, and there is a constantly increasing demand for new and improved systems of providing comfort heating, not only in the home but also in commercial and industrial premises. There is great scope too for the development of further applications of electricity to agriculture and horticulture.

Geographical variations in requirements and diversity between times of use of different appliances or between consumers should have in the future, as in the past, a beneficial effect on what is perhaps the main problem confronting all the Boards and particularly the Generating Board, namely, that of the improvement of the annual load factor. There is much that can and must be done to ensure a steady improvement in the load factor, and the main burden of this task must fall upon the shoulders of the Area Boards, whose off-peak tariffs and restricted-hour tariffs must be sufficiently attractive to obtain as much of this type of load as possible. The scope of future progress may well depend on the extent to which research is pursued throughout the electrical industry into new and improved appliances and methods.

There is little doubt that the future prosperity of our country will be dependent in no small measure on the progress made in electricity supply. With the continuous improvement in efficiency which we can expect, and providing that we do not have to face startling increases in salaries and wages or the cost of fuel, the ever-increasing demands for electricity should be met without any substantial increase in cost to the consumer. Hence the prosperity of our country, and with it the standard of living for all sections of the community, will continue to advance, strengthened by the vitally important factor of an efficient electricity supply industry.

GENERAL NOTES

THE BRITISH SOCIETY OF AESTHETICS

It has recently been decided to form a new Society, under the Presidency of Sir Herbert Read, to promote study, research, discussion and publication of work in aesthetics. The term 'aesthetics' in this connection is understood to include all studies of the arts and related types of experience from a philosophic, scientific or other theoretical standpoint, including those of psychology, sociology, anthropology, cultural history, art criticism and education. 'The arts' include the visual arts and those relating to the theatre, and also music and literature.

The aim of the British Society of Aesthetics will be pursued by organizing courses of lectures, and it is intended to publish the first issue of the Society's Journal this year, even though it may only be in a duplicated form. The Society is making special arrangements for its members to attend the International Congress of Aesthetics which is to be held in Athens from 1st–6th September, 1960.

Membership of the Society costs £2 2*s* alike for private individuals and institutions. Further particulars may be obtained from the Honorary Secretary, The British Society of Aesthetics, c/o The Department of Philosophy, Birkbeck College, Malet Street, London, W.C.1.

COMMONWEALTH TECHNICAL TRAINING WEEK—EMBLEM DESIGN COMPETITION

The City and Guilds of London Institute, who are responsible for the central administration of the Commonwealth Technical Training week to be held in the United Kingdom from 29th May to 4th September, 1961, have announced the offer of prizes of £100, £50 and £25 for an emblem to express the aims of the Week. The offer is open to all past and present students of Technical Colleges and Colleges of Art who are under the age of 25 on 3rd September, 1960, the closing date for the receipt of entries.

The President of the City and Guilds of London Institute, H.R.H. the Duke of Edinburgh, who has been the initiator and principal advocate of the Commonwealth Technical Training Week, has said that it 'is intended to draw attention to the very wide range of apprentice schemes and technical training programmes . . . open to bright and ambitious young people'. The activities planned are also designed to stimulate the responsibility of the community towards young people entering employment; to stress the importance of schemes of induction and training, and generally to emphasize the significant place of the young worker in society.

The emblem will be used throughout the extensive publicity that is being planned by the organizers, who will provide further details about the Week and its objects upon application. Inquiries should be addressed to the Secretary, Commonwealth Technical Training Week, City and Guilds of London Institute, 76 Portland Place, London, W.1.

FELLOWS RECENTLY EXHIBITING IN LONDON

Two Fellows of the Society have recently held exhibitions of their paintings in London. During the first three weeks in June, Mrs. Ellice Endicott, of Boston, Massachusetts, showed a selection of works, notably portraits, at the Alpine Galleries in South Molton Street. Mrs. Endicott was formerly a noted tennis player, and Mr. John P. Marquand remarks in his introduction to her catalogue that it is only within comparatively recent years that she has turned successfully to painting. Her portraits of prominent Americans have achieved a considerable reputation.

At No. 3 Northumberland Avenue, on 13th June, Sir Albert Richardson opened an exhibition of landscapes and portraits by Mr. Lawrence Isherwood. This was Mr. Isherwood's fifth London exhibition, and his forty-fifth one-man show. It remained on view until 10th July.

PICASSO EXHIBITION

The great retrospective exhibition of paintings by Picasso which the Arts Council has organized at the Tate Gallery ranges in time from 1895 to 1959 and includes over 260 pictures, 100 of them being from the artist's own collection. The exhibition remains on view until 18th September, and it is hoped to publish an account of it by Mr. Nevile Wallis in the next issue of the *Journal*.

OBITUARY

We record with regret the deaths of two Fellows of the Society.

SIR FRANCIS BRAKE

Sir Francis Joseph Edwin Brake, M.I.E.E., M.I.Prod.E., who died on 13th June, aged 70, occupied a leading position in the telecommunications industry. He was Chairman of Creed & Co. Ltd., Vice-President of the International Standard Electric Corporation and a Director of Standard Telephones and Cables Ltd., Standard Telecommunications Laboratories Ltd., and the Commercial Cable Co. Ltd. A former Vice-Chairman of British South American Airways, he was at the time of his death a member of the board of the British Overseas Airways Corporation Associated Companies Ltd.

During the Second World War Brake served at the Ministry of Aircraft Production as Controller of Construction and Regional Services and as a member of the Air Supply Board. He received a knighthood in 1946. He was a Freeman of the City of London, a Member of the Worshipful Company of Gold and Silver Wyre Drawers and a Life Governor of Haileybury and the Imperial Service College. He became a Fellow of the Society in 1956.

MAJOR A. M. FITZPATRICK-ROBERTSON

Major Antony Mario Fitzpatrick-Robertson, who died in London on 27th June, aged 63, had been a faithful supporter of the Society's work and objects since his election as a Fellow in 1950. He was educated at Stonyhurst and in several countries on the continent, and during the First World War served in The Connaught Rangers and The Royal Dublin Fusiliers. Thereafter he settled at Cowes, and became a well-known figure in that neighbourhood, serving on various Local Government Committees and sharing enthusiastically in the local preoccupation with yachting. He was a former Chairman of Cowes Urban District Council, and a Governor of University College, Southampton. Since 1925 he had been in business on his own account as a valuer and dealer in antiques, for which he had great feeling.

NOTES ON BOOKS

DISCOURSES ON ART. *By Sir Joshua Reynolds. Edited by Robert R. Wark. San Marino (Calif.), Huntington Library. London, Oxford University Press*, 1959. £4 *net*

This new edition is most welcome. We should be grateful for any publication which encourages a study of the *Discourses*, for it is a melancholy fact that though almost everyone at any rate, knows of the *Discourses*, only too few have really read them. This is especially true, alas, of young artists, though if prejudice was put aside they would find much to learn. This prejudice is largely due to a tendency—from which Reynolds himself was free—to seek to praise one artist by the disparagement of others. Because Blake and his followers have been of late (and very rightly) greatly admired, Blake's rather childish attacks on Reynolds and the foolish marginal comments he made on his copy of the *Discourses* have too often been taken at their face value. Moreover, in recent years an influential group of talented painters and writers not content with their admiration of Gainsborough have held up Reynolds as a sort of arch-bore, the best function of whose dullness was to intensify the brilliance of Gainsborough—forgetting, perhaps being unaware, how much more understandingly and generously Reynolds himself in his fourteenth *Discourse* had praised him.

In whatever estimate Reynolds as a painter of commissioned portraits may be held, surely it is unfair to deny him courage and inventiveness? Few portrait painters have so frequently taken such astonishing risks or in doing so have scored so high a proportion of hits to misses. Dullness, it might be thought, was the last thing of which the painter of 'The Archers' (Viscount Sydney and Colonel John Dykes Acland), of the Honble. Augustus Keppel by the sea-shore, or of the Duchess of Devonshire dandling her child, could reasonably be accused. His writings are of especial value for their affirmation of fundamental truths, and in the dilemma in which we find ourselves at the present day they should be all the more acceptable as coming from a man who himself knew doubt, and who struggled, more successfully than is widely acknowledged, to reconcile in his work the conflicting strains in his character. To give but one instance of the applicability of his precept—indeed of his foreknowledge—he warns us of the necessity 'to discriminate perfections that are incompatible with each other'. Is not the turgidity and aesthetic indigestion from which some contemporary painting suffers due to neglect of just such a warning?

Here anyway is another chance, very handsomely presented, for us to read what he actually said. Besides the width and wisdom of Reynolds' mind and the interest of what he had to say for artists and students of art, the *Discourses* are most beautifully written: they have exactitude and elegance, his meaning is made clear and the most subtle distinctions are made with ease and pace.

Mr. Wark has written a clear and informative introduction, but perhaps the greatest value of this book will be to those to whom the actual 'writing' of Reynolds gives pleasure, and these will find Mr. Wark's annotations fascinating, for they show by a simple system of references in the form of footnotes, the corrections and alterations Reynolds made to his text after the first publication of the *Discourses*. Often the reasons which led him to make changes in sense or in form seem clear, and then all is gain; but occasionally we may think that modifications have been made at the expense of a certain freshness. This risk every artist knows, and all worth their salt must face. Mr. Wark also places us in his debt by reproducing many of the paintings to which Reynolds refers. I do not think this has been done before: it clarifies the argument, and by enabling us to follow it more easily greatly adds to our enjoyment. He also includes reproductions of two of Reynolds' own pictures—both in the Huntington Library. Perhaps this choice was due to local piety, but it is to be lamented that better examples were not chosen, for these give but a poor impression of his great gifts,

and though they are chosen to illustrate what Mr. Wark calls, I do not think happily, his 'two styles', in fact both merely illustrate Reynolds' weaknesses and not his strength, and might prove very misleading to readers who are unfamiliar with the body of his work. Indeed I do not think Mr. Wark's introduction shows a very sensitive awareness of what Reynolds' special gifts as a painter consist in. But this, which is a matter of opinion, should in no way lessen our gratitude to the Huntington Library, which has sponsored this beautifully printed edition, or to Mr. Wark, whose careful scholarship has made it possible for us to re-read the *Discourses* with such greatly enhanced pleasure.

ALLAN GWYNNE-JONES

DECORATIVE ART, 1959–60. *Edited by Henry Fuller. London, The Studio,* 1959. 35*s net*

All who are interested in the progress of design in furnishing and decoration must appreciate the annual survey of this field which The Studio has conducted for so long with such remarkable regularity and consistency. The make-up of this forty-ninth volume follows the pattern of its predecessors and contains several hundred illustrations of recent designs from all parts of the world, grouped in seven main sections entitled Houses and Apartments; Interiors and Furniture; Tableware and Silver; Textiles; Glassware; Ceramics and Metals; and Light Fittings. There seems to be no particular intention that these sections should balance each other either in coverage or in standard of merit of the work illustrated, the first being little more than a token acknowledgement that the house or flat is at least as important as its furniture and bric-à-brac, while the last is a slightly depressing summary of what is admittedly a rather depressed subject.

If you take a quick run through the main body of the illustrations without reading the captions you are left with rather definite impressions that this was not a specially notable year—perhaps a time to consolidate rather than to advance—and that the work of one country is pretty well interchangeable with that of another. A more careful examination leads of course to these impressions being modified in particular cases, but in general they remain. If a thing is strikingly good it is as likely as not to be Japanese; if not Japanese, Finnish; if neither, Danish. If an international council were so rash as to nominate a designer of the year, few others would be on the short list with Tapio Wirkkala. There are not many interiors that one particularly notices; furniture is almost uniformly respectable even where showing too much of its little steel legs; tableware (china and earthenware) is very dull, and silver has little to show; textiles provide the most stimulating and imaginative section, and it is arguable for this reason and others that all the fourteen pages of colour plates should have been given to this section; glass is good, bad and indifferent: so many glasses are photographed in unfamiliar studio lighting conditions that one is in danger of comparing the merits of glass-as-photographed rather than of glass; ceramics, finally, which here means studio pottery, is anything you like to make it.

In a sensible, witty and provocative introduction, Terence Davis finds that Delight, in the form of decoration, is beginning to make up some leeway on Commodity and Firmness, but is still far from running abreast. He berates some prominent designers and others for bad propaganda in living in Georgian houses furnished out of the junk shops, but makes no allowance for the fact that the old house and the junk cost only a half or a fifth or a tenth of the price of the new; and he might pause to consider that for the designer of new things the good work of his predecessors may offer more rewarding lessons than that of his contemporaries which so nearly resembles his own.

With several hundred plates illustrating more than a thousand designs, the book is modest in price.

R. Y. GOODDEN

THE DEVELOPMENT OF THE ARCHITECTURAL PROFESSION IN BRITAIN. *By Barrington Kaye. London, Allen & Unwin*, 1960. 21*s.* net.

This book is a sociological analysis of the origin and growth of professionalism in the field of architecture in Britain. It is concerned neither with the value of architecture, nor even with that of the architectural profession in broad context, because it is itself the product of another branch of professionalism and its findings are limited by the method of arriving at them.

What it does is to pin down professionalism as a product of nineteenth-century *laissez faire* and to follow in detail its course towards a consummation in something as near the closed shop as the vulnerable nature of its activities permit.

And this is the rub, for whether architecture is an art, or a craft, or a business, or a branch of science has never been, and perhaps never will be, answered to general satisfaction. Its professionalism is concerned with establishing an effective relationship with its clientele in a competitive society by exercising a discipline of ethical conduct over its members, by controlling education and the entry into its ranks, and by enforcing a scale of charges; that is, by becoming as respectable as the best of them and as far as possible divorced from the industry of which it could in another context be considered a part.

But always at its growing point it is an art that it is not to be confined by the limits of a profession because it seeks comprehensiveness. Thus to-day the problems of *urban renewal* need architect-planners, but architecture has hived off town planning as a separate profession, and in the creation of a comprehensive scheme of renewal to-day over half a dozen professions or near-professions must somehow dovetail their specialized knowledge and skills.

This is indeed the age of professionalism, and none could deny that professionalism as an answer to the special circumstances of nineteenth-century materialism has advanced knowledge in every branch of human activity. But 'the dangers arising from . . . professionalism', as A. N. Whitehead noted as long ago as 1925, 'are great, particularly in our democratic societies. The directive force of reason is weakened. The leading intellects lack balance . . . the specialized functions of the community are performed better and more progressively, but the generalized direction lacks vision . . the novel pace of progress requires a greater force of direction if disasters are to be avoided.'

The book is an analysis but it is the reverse of dull. I found its exposition of the reaction of architecture, or rather of the body of architects, to the pressures of an industrialized and competitive society fascinating, and it left me, as it should, trying to assess the nature of the changed forces now bearing upon us and tending, as I believe, to make professionalism less useful as the need for a wider view of our responsibilities emerges. I am sure that advanced scientific thought would support us in thinking that the problems that face architecture to-day are so inter-connected with other aspects of life that the wide view—I am tempted to say the artist's comprehensive view—has a value that outweighs what professionalism can do alone. The problem is how to further it without destroying the residual value of architecture considered as a profession.

E. MAXWELL FRY

THE HISTORY OF THE CROSS. *By Norman Laliberte and Edward N. West. New York and London, the Macmillan Company*, 1960. 3 *guineas net*

The title of this handsome but over-expensive book is rather misleading. It suggests a re-telling of medieval legend, or a modern version of apocryphal gospels; but it is in fact appended to a description by a Canon of New York Cathedral of the symbolic usages of the form of the cross, both pagan and Christian. That form is not the same thing as the crucifix. As Canon West points out, the image of the cross has

been used by nearly all the great religions, with widely differing import, and the relation of these to the central Christian symbol would appear to be fortuitous. The Jewish gallows on which Jesus died was T-shaped: some authorities would say Y-shaped. Whichever it was, early Christian iconographers were not interested in 'realism' as we would understand it to-day; and the earliest portrayal of the crucified Christ which purports to be naturalistic dates from the late sixth century. The extension of the upright to form what we know as the 'Latin' cross was the result of adding the superscription by Pilate. Indeed, for the Christian the cross would have no value without the crucified: it is the particular death that took place upon it which matters, not the shape of the cross as such.

Nevertheless, Christian artists and iconographers have down the centuries evolved a large variety of crosses, each one with its own particular symbolism, and it is with that development that this book is concerned. Canon West's account is brief but lucid and well documented. He is wrong, however, in describing St. Paul's Cathedral as being in the shape of a Greek cross—unless he had Wren's first design in mind, but this he does not make clear. He does, however, provide valuable material for further study, and gratifyingly raises more questions than he answers as to the relation between the symbolism of pagan crosses and their Christian counterparts.

The most attractive and important feature of the book is the art of Norman Laliberte. His nervous and childlike style is admirably suited to the portrayal of what the crucifixion of Christ has meant to the human imagination. These illustrations are not just reproductions of various crosses and crucifixes. Instinctive and tentative in expression, they are a genuine contemporary comment upon the religious significance of the cross, and therefore deserve in every sense to be called illuminations of the text.

GLEN CAVALIERO

MODERN ART EDUCATION IN THE PRIMARY SCHOOL. *By Max Dimmack. London, Macmillan,* 1959. 42*s. net*

Before opening this book it is essential for the British reader to understand that in Australia primary education is concerned with all forms of teaching up to the University level. This means that the gargantuan task of this 150-page book is to discuss the history and development of child art, modern methods of teaching, the rôle of the teacher and the equipment and materials needed for what its author calls the 'areas of activity' relating to boys and girls ranging in age from infancy to late adolescence.

Mr. Dimmack is a lecturer at a Teacher's Training College in Victoria, Australia, and his book, dedicated to his students, includes much information about their research experiments and those of his colleagues. These alone make it complementary to that of Miss Lindstrom whose work in San Francisco was reviewed here in 1958. [*Journal*, August, 1958, p. 733.]

Writing in a curious combination of English and American educational terminology, the author begins well by describing the currently prevailing situation in art education throughout his country. He admits that the standard of work produced is often poor, colourless and uninteresting and that the teaching lacks inspiration and flexibility, little attempt being made to relate the subject to the child being taught or to life itself—a situation this writer can readily believe in from the evidence of paintings by several young Australian boys who have come under his supervision in recent years. A comparison of work from different countries published annually by Shankar's weekly enables one to detect a certain lack of imagination and a sameness of media in the Australian pictures. The reasons for this are, according to Mr. Dimmack, the vast distances which teachers must travel to make contact with each other, the lack of an Australian central art education advisory board, the absence of travelling exhibitions concerned with children's art and the

shortage of specialist teachers having first hand knowledge and experience of European or American culture. It seems a pity that more stress was not laid on the desirability of having practising artists teaching in schools; but as an alternative there would seem to be desperate need for greater exchange between the three continents of itinerant specialist art teachers.

This book primarily fulfils the needs of those untrained for teaching art and untutored in the prevalent methods of motivation, but who find themselves for one reason or another actually teaching this most complex subject in Australia. Therefore much of the text reads like the fully written up lecture notes of a two-year course at a training college, and most probably that is what it is. However, no fault can be found in this, as doubtless the author is breaking fresh literary ground in Victoria. The trained teacher here will find little new and much that is already available in the works of R. R. Tomlinson, Dr. Viola and Miss Richardson (to whom full credit is given), although he will possibly find comfort in the thought that on the opposite side of the world others are striving for a similar end product in much the same way as we are. Just as so often happens in England, the Australian art master is expected to improvise his media to the extent of being a sort of cultural Robinson Crusoe.

The condensed form that this serious text book has been made to take on puts it at a distinct disadvantage. Apart from an appalling dust jacket and title page it is sensibly laid out with a series of excellent if small illustrations. The bibliography and appendices are further proof of both the depth to which Mr. Dimmack has studied British, American and German scholastic methods and the range of his ingenuity at meeting the old demands of economy in materials, the book itself revealing his desire to stimulate a fresh approach and a new enthusiasm in the pedagogue of his country.

MICHAEL R. PRESTON

FAUVES AND CUBISTS. *By Umbro Apollonio. London, Batsford,* 1960. 63*s. net*

For the most sensible of reasons, the publishing of heavily illustrated art books has become an international operation. 'This is a Bandwaggon publication', says the jacket—but nine times out of ten it has been printed elsewhere in Europe and one wonders how much control Messrs. Bandwaggon Publications have in fact had over its production.

Fauves and Cubists points some of the hazards involved in this remote control publishing, as well as raising afresh the real purpose and value of much of the present spate of rather expensive picture books. It seems to me that there are only three valid excuses for trampling ground as familiar as this all over again. The book must be better informed than others of its kind, or more lucidly written: it must add to our store of knowledge of the subject. Or, if it is largely a picture book, its reproductions must be of a higher quality, or more numerous, or of more rarely seen originals, than are offered elsewhere. Or, failing these, the book must be cheaper than any of a comparable nature, so that whatever it has to offer may become available to a wider public than before.

I have a high regard for Batsford in general, but it seems to me that *Fauves and Cubists* is none of these things. The 64 colour plates are of a desperate familiarity; their quality is variable but some at least, unless my memory misleads me, fall far short of the best that can be done. The text is a turgid and laboriously translated *rechauffée* of well documented material. (Sample sentence for style: 'Considering the terms of our enquiry which is, above all, concerned to illustrate movements in a general way, we can deem such investigation to be superfluous; we are even compelled to exclude study of those works which not only assesses their quality but makes detailed reference to the cultural pattern from which such quality directly derives and on which it bases its development.') It is not helped by unimportant but

irritating mispellings and literals (Gloizes, Raynel, *bistrot*, *Voulupté*, 1812 for 1912, etc.). All this might be excusable if the book were cheaper; it is not good enough at three guineas.

In short, *Fauves and Cubists* is one of those books—and they are by no means uncommon nowadays—which seem destined to be used as 'prestige objects' in the casually cultured home.

MICHAEL MIDDLETON

SHORT NOTES ON OTHER BOOKS

CHILDREN IN THE CLOSE. *By Geraldine Symons. Illustrated by Helen Symons. London, Batsford, 1959. 18s. net*

Reminiscences of childhood, centring on Salisbury Close in the years just before and after 1914: a book to be contrasted with Flora Thompson's evocation of humbler village life a quarter of a century earlier.

WOLFE: PORTRAITURE AND GENEALOGY. *Quebec House Permanent Advisory Committee, 1959*

The work of future biographers will be assisted by these three scholarly articles on 'The Likeness of Wolfe', his genealogy and descent, and the chronology of his life (with historical tables showing the principal events of his time), by J. F. Kerslake, Anthony Wagner and W. W. Shaw-Zambra respectively. There are 31 illustrations, including a particularly valuable sequence devoted to portraits of Wolfe.

TELEGRAPHS IN VICTORIAN LONDON. *By John Durham. Cambridge, Golden Head Press, 1959. 15s net*

In 1857 Sydney Waterlow initiated the first overhead telegraph system in London, and so prepared the way for the operations of the London District Telegraph Company (1859) and the Universal Private Telegraph Company (1860). Mr. Durham tells of the rise and eventual failure of these two private enterprises, in the days before telegraphy became the responsibility of the State.

PICTURES FROM A MEDIEVAL BIBLE. *Commentary by James Strachan. London, Darwen Finlayson, 1959. 15s net*

Mr. Strachan's *Early Bible Illustrations* (reviewed in the *Journal* for April, 1958, p. 380) was mainly concerned with the meaning and origin of the illustrations in the Great Bible of Henry VIII, and was necessarily of specialist interest. The present selection of pictures has been made from the Cologne Bible of 1478-80, and is intended to appeal to those interested in the stories illustrated rather than in the historical details of printing.

MANAGEMENT SURVEY. *By Sir Frederic Hooper. Harmondsworth, Penguin Books, 1960. 3s 6d net*

A general welcome will be given to this inexpensive reprint of Sir Frederic's lucid exposition of the managerial problems of to-day, and of the systematic thinking on which solutions to them may be based.

FROM THE JOURNAL OF 1860

VOLUME VIII. 31*st August*

ENGLISH EARNEST AND ENGLISH FUN

MUCH WENLOCK AGRICULTURAL READING SOCIETY.—The annual meeting of the Olympian Class of this Institution took place on Tuesday and Wednesday, the

21st and 22nd instant. At the request of the mayor, magistrates, town councillors, and inhabitants of the borough, Lieut.-Colonel Sir Herbert Benjamin Edwardes delivered an Address to . . . the Olympian class. He said: 'Good friends of Wenlock and of Shropshire, it is a great pleasure to see such a gathering as this for making a holiday. There's a great deal too much work in the world—too much work for our profit, I mean—for of working for others—of self-sacrifice and self-devotion—there is never too much. Men are too much slaves to their occupations now-a-days. There is a perfect idolatry of labour, which leaves no margin for home, or holiday, or the inner life. I rejoice, therefore, to see this thorough determination of the good folks of Wenlock to have a regular game of play once a year at any rate. . . . I would venture, if you will allow me, to suggest the selection of another name for this particular class. The name 'Olympian' is a good name in one respect, it classically expresses that union of mental and physical training, and mental and physical competition, which is your object, and which was the characteristic of the renowned games of Greece. But why should England adopt a heathen and a foreign name? Let me advise you then to call this thoroughly English class by a thoroughly English name. Call it the Shropshire Class of British Work and Play, or anything else you will; but let it tell of English men and women, English boys and girls, English labours and English holidays, English earnest and English fun. Again, I see among your sports the practice of the bow. Now let no Englishman speak slightingly of the 'cloth-yard shaft', which ere now has measured the length of many an enemy on foreign soil. But there is a time for all things, and the time for archery as a martial exercise has gone by for ever. We live in days when the whole art of war has been revolutionised by the rifle. It is impossible then that the arrow can ever fly again in a foughten field. And if unfit for real war, does it not become unfit for athletic sport? Does it not lose its interest as an exercise for men? To them the very charm and life of any sport is its imagery of earnest; and the earnest has gone out of archery. For the future, then, I would say to the men of Wenlock, 'resign your bow and quiver into gentler hands; trust these innocent weapons to the fair, who, when they aim at human hearts, mean them no harm!' For the stern men of England henceforward the national weapon is the rifle. And I am glad to see that this year you have for the first time introduced rifle shooting among your Wenlock games. This is giving it its true place. The volunteer movement will never be safe till rifle-shooting has become the national game of our day, as the popinjay and archery of yore. It is a more reasonable and intelligent weapon, less dependant on brute force, but not on that account less manly, for its practice requires great discipline of all the manly qualities. It develops individual intelligence, self-reliance, patience, thoughtfulness, and sobriety, for no drunkard will ever do anything with the rifle. The rifle is only *domesticated* in countries renowned for national liberty and individual independence. If, men of Wenlock, you wish to bring about this result in your own town, I would counsel you to apply to some one of your many tried and liberal friends among the landed gentry to rent you a piece of meadow land to be the playground of your town. It does not do to be always borrowing a field. Rent one, and be independent; so that any day of the week, except Sunday, you may be able to practise your rifles, or have a game of cricket or foot-ball. And now, my friends, I wish you a good day. May your Wenlock games long flourish. May they extend all over Shropshire, and make Shropshire men still better and stouter than they are.'

The Sports commenced with Rifle shooting, but owing to the wetness of the weather the only other games that came off were the following:—A foot hurdle race, one mile, over 14 hurdles, open to all England . . . [and] a foot race, 400 yards . . .

The proceedings were brought to a close by a concert in the evening, which was successful.